Nokia Customer Care

Service Manual

RM-170; RM-171 (Nokia E50)
Mobile Terminal
Part No: 9251885 (Issue 1)

COMPANY CONFIDENTIAL

Amendment Record Sheet

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IMPORTANT

This document is intended for use by qualified service personnel only.

Warnings and cautions

Warnings

- IF THE DEVICE CAN BE INSTALLED IN A VEHICLE, CARE MUST BE TAKEN ON INSTALLATION IN VEHICLES FITTED WITH ELECTRONIC ENGINE MANAGEMENT SYSTEMS AND ANTI-SKID BRAKING SYSTEMS. UNDER CERTAIN FAULT CONDITIONS, EMITTED RF ENERGY CAN AFFECT THEIR OPERATION. IF NECESSARY, CONSULT THE VEHICLE DEALER/ MANUFACTURER TO DETERMINE THE IMMUNITY OF VEHICLE ELECTRONIC SYSTEMS TO RF ENERGY.
- THE PRODUCT MUST NOT BE OPERATED IN AREAS LIKELY TO CONTAIN POTENTIALLY EXPLOSIVE ATMOSPHERES, FOR EXAMPLE, PETROL STATIONS (SERVICE STATIONS), BLASTING AREAS ETC.
- OPERATION OF ANY RADIO TRANSMITTING EQUIPMENT, INCLUDING CELLULAR TELEPHONES, MAY INTERFERE WITH THE FUNCTIONALITY OF INADEQUATELY PROTECTED MEDICAL DEVICES. CONSULT A PHYSICIAN OR THE MANUFACTURER OF THE MEDICAL DEVICE IF YOU HAVE ANY QUESTIONS. OTHER ELECTRONIC EQUIPMENT MAY ALSO BE SUBJECT TO INTERFERENCE.
- BEFORE MAKING ANY TEST CONNECTIONS, MAKE SURE YOU HAVE SWITCHED OFF ALL EQUIPMENT.

Cautions

- Servicing and alignment must be undertaken by qualified personnel only.
- Ensure all work is carried out at an anti-static workstation and that an anti-static wrist strap is worn.
- Ensure solder, wire, or foreign matter does not enter the telephone as damage may result.
- Use only approved components as specified in the parts list.
- Ensure all components, modules, screws and insulators are correctly re-fitted after servicing and alignment.
- Ensure all cables and wires are repositioned correctly.
- Never test a mobile phone WCDMA transmitter with full Tx power, if there is no possibility to perform the measurements in a good performance RF-shielded room. Even low power WCDMA transmitters may disturb nearby WCDMA networks and cause problems to 3G cellular phone communication in a wide area.
- During testing never activate the GSM or WCDMA transmitter without a proper antenna load, otherwise GSM or WCDMA PA may be damaged.

ESD protection

Nokia requires that service points have sufficient ESD protection (against static electricity) when servicing the phone.

Any product of which the covers are removed must be handled with ESD protection. The SIM card can be replaced without ESD protection if the product is otherwise ready for use.

To replace the covers ESD protection must be applied.

All electronic parts of the product are susceptible to ESD. Resistors, too, can be damaged by static electricity discharge.

All ESD sensitive parts must be packed in metallized protective bags during shipping and handling outside any ESD Protected Area (EPA).

Every repair action involving opening the product or handling the product components must be done under ESD protection.

ESD protected spare part packages MUST NOT be opened/closed out of an ESD Protected Area.

For more information and local requirements about ESD protection and ESD Protected Area, contact your local Nokia After Market Services representative.

Care and maintenance

This product is of superior design and craftsmanship and should be treated with care. The suggestions below will help you to fulfil any warranty obligations and to enjoy this product for many years.

- Keep the phone and all its parts and accessories out of the reach of small children.
- Keep the phone dry. Precipitation, humidity and all types of liquids or moisture can contain minerals that will corrode electronic circuits.
- Do not use or store the phone in dusty, dirty areas. Its moving parts can be damaged.
- Do not store the phone in hot areas. High temperatures can shorten the life of electronic devices, damage batteries, and warp or melt certain plastics.
- Do not store the phone in cold areas. When it warms up (to its normal temperature), moisture can form inside, which may damage electronic circuit boards.
- Do not drop, knock or shake the phone. Rough handling can break internal circuit boards.
- Do not use harsh chemicals, cleaning solvents, or strong detergents to clean the phone.
- Do not paint the phone. Paint can clog the moving parts and prevent proper operation.
- Use only the supplied or an approved replacement antenna. Unauthorised antennas, modifications or attachments could damage the phone and may violate regulations governing radio devices.

All of the above suggestions apply equally to the product, battery, charger or any accessory.

Company Policy

Our policy is of continuous development; details of all technical modifications will be included with service bulletins.

While every endeavour has been made to ensure the accuracy of this document, some errors may exist. If any errors are found by the reader, NOKIA MOBILE PHONES Business Group should be notified in writing/e-mail.

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- Page(s) and/or Figure(s) in error

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Battery information

Note: A new battery's full performance is achieved only after two or three complete charge and discharge cycles!

The battery can be charged and discharged hundreds of times but it will eventually wear out. When the operating time (talk-time and standby time) is noticeably shorter than normal, it is time to buy a new battery.

Use only batteries approved by the phone manufacturer and recharge the battery only with the chargers approved by the manufacturer. Unplug the charger when not in use. Do not leave the battery connected to a charger for longer than a week, since overcharging may shorten its lifetime. If left unused a fully charged battery will discharge itself over time.

Temperature extremes can affect the ability of your battery to charge.

For good operation times with Ni-Cd/NiMh batteries, discharge the battery from time to time by leaving the product switched on until it turns itself off (or by using the battery discharge facility of any approved accessory available for the product). Do not attempt to discharge the battery by any other means.

Use the battery only for its intended purpose.

Never use any charger or battery which is damaged.

Do not short-circuit the battery. Accidental short-circuiting can occur when a metallic object (coin, clip or pen) causes direct connection of the + and - terminals of the battery (metal strips on the battery) for example when you carry a spare battery in your pocket or purse. Short-circuiting the terminals may damage the battery or the connecting object.

Leaving the battery in hot or cold places, such as in a closed car in summer or winter conditions, will reduce the capacity and lifetime of the battery. Always try to keep the battery between 15°C and 25°C (59°F and 77° F). A phone with a hot or cold battery may temporarily not work, even when the battery is fully charged. Batteries' performance is particularly limited in temperatures well below freezing.

Do not dispose of batteries in a fire!

Dispose of batteries according to local regulations (e.g. recycling). Do not dispose as household waste.

Nokia E50 Service Manual Structure

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2 Parts Lists and Component Layouts
3 Service Software Instructions
4 Service Tools and Service Concepts
5 Disassembly/reassembly instructions
6 BB Troubleshooting and Manual Tuning Guide
7 RF Troubleshooting and Manual Tuning Guide
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9 System Module
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1 — General Information

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Product selection

Nokia RM-170/171 is the first GSM quadband mobile phone in ES supporting 850/900/1800/1900 MHz bands.

RM-170/171 supports EGPRS packet data connection (EDGE) in all these bands. Supported multislot class for both GPRS and EGPRS is MSC 10. RM-170/171 is based on G3.1S, RAP GSM engine.

According to GSM standard 05.05 it responds to class 4 (max. 2W) in EGSM 900, class 1 (1W) in GSM 1800 and class 1 in GSM 1900. It also supports Bluetooth 1.2 standard. The handset has a full phase 2 Type Approval and it complies with the GSM Type Approval. RM-170/171 also has a full CE approval and FCC approval.

RM-170 has a 1.3 megapixel camera with digital zoom up to 5x, there is no camera in RM-171.

Note: All subsequent references to camera concern RM-170 only.

Imaging is supported in familiar landscape camera mode with dedicated camera key. Display resolution is 320x240 and supports 262, 144 colours.

The MMS implementation follows the OMA MMS 1.2, AMR and SMIL.

WAP 2.0 compatible XHTML browser over HTTP/TCP/IP stack communicates with a gateway in network.

The supported UI is S60 release 3.0.

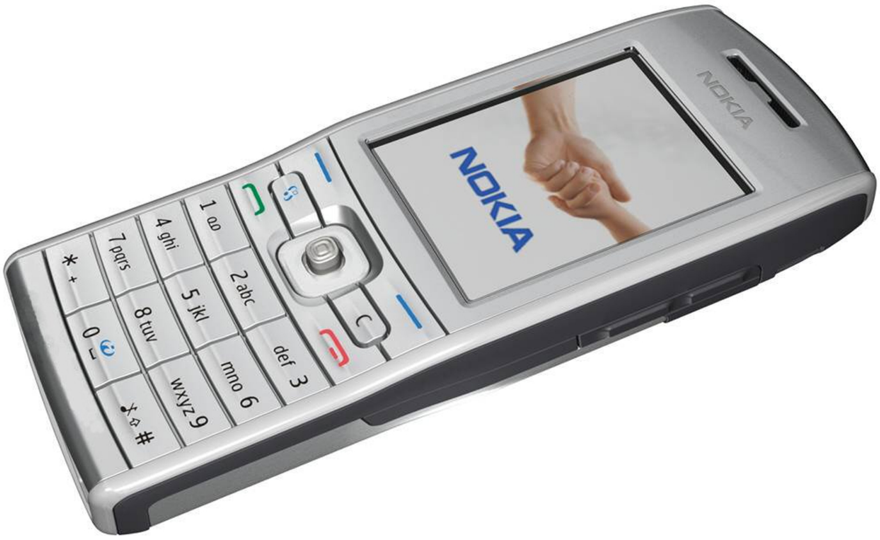

Figure 1 View of RM-170/171

Product features and sales package

Imaging

- Active QVGA colour display, 262,144 colours
- High Resolution 320x240 pixels, active area 33.48mm x 44.64mm
- 1.3MPix camera with integrated camera light
- Landscape mode for image capturing
- MicroSD card socket (hot swap)

Bearers & transport

- Quadband EGSM 900, GSM 850/1800/1900 supporting EDGE (rel. 99)

Software platform

- SW platform: Nokia Series 60

Connectivity

- USB 2.0 full-speed
- Bluetooth 1.2
- Pop-Port™ connector with ACI
- IrDA (115 kbps)

Productivity

- SMS, MMS and email
- MS Word, PowerPoint , Excel and Adobe PDF viewers
- PIM (Calendar & Contacts)
- Internet browser
- Video streaming (3GPP)
- Push to Talk
- Logs (last calls , timers and history list)
- Audio messaging
- Java™ MIDP 2.0, CLDC 1.13D API, PIM API, File access API
- MP3
- Data Transfer
- Settings Wizard/Access Point Configurator

Sales package

- Transceiver RM-170/171
- BL-5C Li-Po Battery Cell
- AC Charger AC-4
- All-in-one User Guide (warranty card + accessory info + getting started sheet + invitational module for Club Nokia)
- CD-ROM
- Mono Headset HS-5 (Hong Kong HS-23)
- USB Cable CA-53
- MicroSD card MU-26
- Add-on application guide

Product and module list

Module name	Type code	Notes
System/RF Module	1UT	Main PWB with components.

Mobile enhancements

Table 1 Audio

Enhancement	Type
Boom mono headset	HDB-4

Enhancement	Type
Mono headset	HS-5
Classic stereo headset	HS-23
Loopset	LPS-4
Wireless headset	HDW-3
	HS-4W
	HS-11W
	HS-58W
	HS-25W
Wireless clip-on headset	HS-21W
Wireless stereo headset	HS-12W
Music stand	MD-1

Table 2 Car

Enhancement	Type
Nokia car kit phone	N616
Headrest handsfree	BHF-3
Basic handsfree	HF-3
Advanced car kit (sales pack) (EURO 1)	CK-7W
Car kit	CK-10
Plug-in car handsfree	HF-6W
Mobile holder	CR-66

Table 3 Data

Enhancement	Type
USB cable	CA-53
(USB cable)	(DKU-2)
PC suite	

Table 4 Imaging

Enhancement	Type
Nokia image album	PD-1
Nokia remote camera	PT-6

Table 5 Messaging

Enhancement	Type
Nokia digital pen (Eur/US)	SU-1B
Nokia digital pen (Eur/US)	SU-27W
Bluetooth QWERTY keypad (Scandinavian EURO 1)	SU-8W

Table 6 Power

Enhancement	Type
Compact charger	AC-3
Battery Li-on	BL-5C
Travel charger	AC-4
Retractable charger	AC-1
Charger adapter	AC-44
Mobile charger	DC-4

Technical specifications

Transceiver general specifications

Unit	Dimensions (L x W x T)	Weight (g)	Volume (cm^3)
Transceiver with BL-5C battery	113 x 43.5 x 15.5	104	70

Main RF characteristics for GSM850/900/1800/1900 (quadband) and EDGE phones

Parameter	Unit
Cellular system	GSM850, EGSM900, GSM1800/1900 and EDGE
Rx frequency band	GSM850: 869 - 890 MHz
	EGSM900: 925 - 960 MHz
	GSM1800: 1805 - 1880 MHz
	GSM1900: 1930 - 1990 MHz
Tx frequency band	GSM850: 824 - 849 MHz
	EGSM900: 880 - 915 MHz
	GSM1800: 1710 - 1785 MHz
	GSM1900: 1850 - 1910 MHz
Output power	GSM850: +5 ... +33dBm/3.2mW ... 2W
	GSM900: +5 ... +33dBm/3.2mW ... 2W
	GSM1800: +0 ... +30dBm/1.0mW ... 1W
	GSM1900: +0 ... +30dBm/1.0mW ... 1W

Parameter	Unit
EDGE output power	EDGE850: +5 ... +29dBm/3.2mW ... 2W
	EDGE900: +5 ... +29dBm/3.2mW ... 2W
	EDGE1800: +0 ... +26dBm/1.0mW ... 1W
	EDGE1900:+0 ... +26dBm/1.0mW ... 1W
Number of RF channels	GSM850: 124
	GSM900: 194
	GSM1800: 374
	GSM1900: 299
Channel spacing	200 kHz
Number of Tx power levels	GSM850: 15
	GSM900: 15
	GSM1800: 16
	GSM1900: 16
Number of EDGE Tx power levels	GSM850 EDGE: 12
	GSM900 EDGE: 12
	GSM1800 EDGE: 14
	GSM1900 EDGE: 14

Battery endurance

Battery	Capacity (mAh)	Talk time	Stand-by
BL-5C	970mAh	up to 6.8 hrs	up to 200 hours

Charging times

AC-4
Up to 1 h 40 min

Environmental conditions

Environmental condition	Ambient temperature	Notes
Normal operation	-15ºC...+55ºC	Specifications fulfilled
Reduced performance	-25ºC...-15ºC +55ºC...+70ºC	Operational for shorts periods only
Intermittent operation	-40ºC...-25ºC +70ºC...+85 ºC	Operation not guaranteed but an attempt to operate does not damage the phone.

Environmental condition	Ambient temperature	Notes
No operation or storage	<-40ºC...>+85ºC	No storage or operation: an attempt may damage the phone.
Charging allowed	-25ºC...+50ºC	
Long term storage conditions	0ºC...+85ºC	

2 — Parts Lists and Component Layouts

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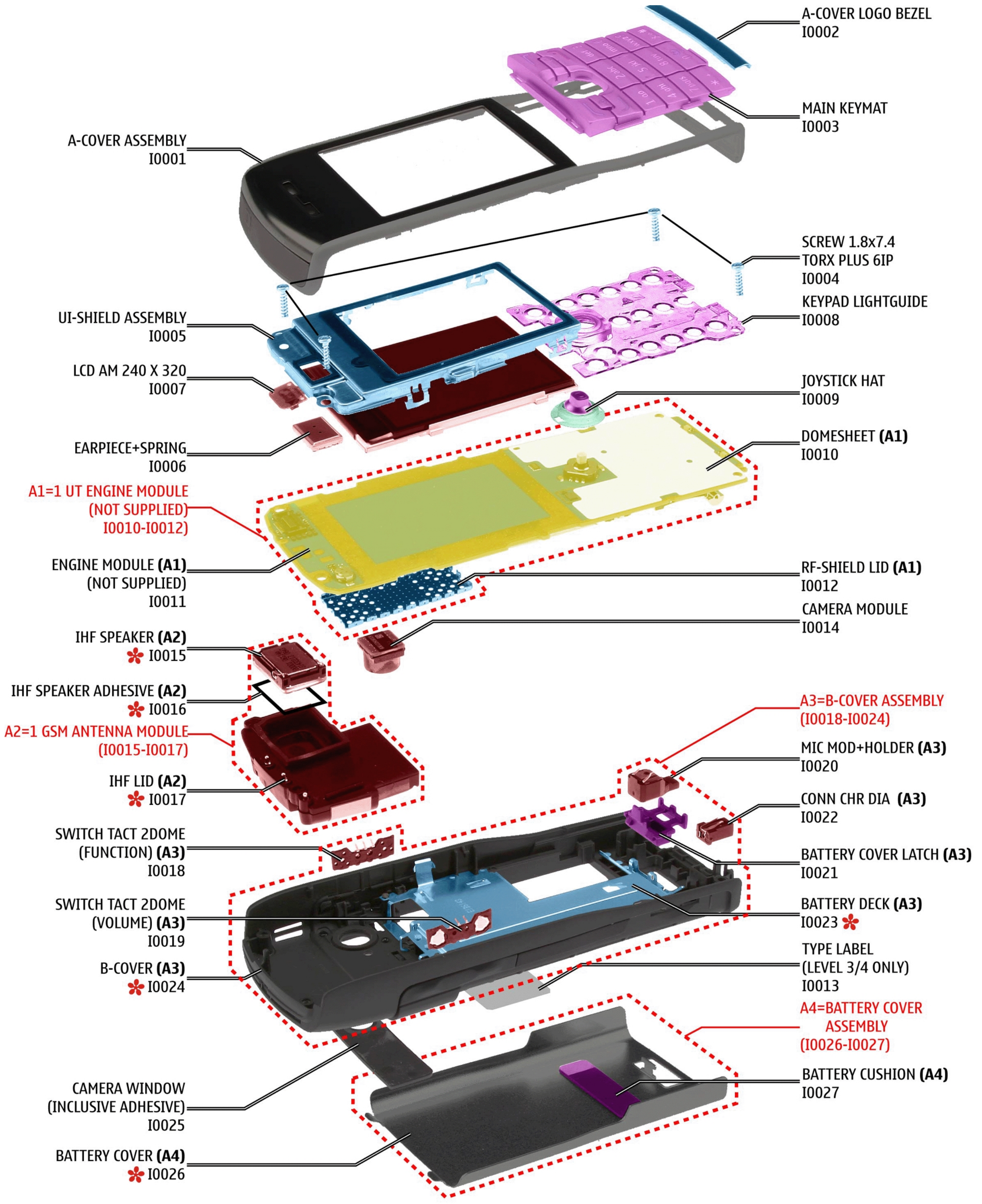
Exploded view


A-COVER LOGO BEZEL
I0002
MAIN KEYMAT
I0003
A-COVER ASSEMBLY
I0001
SCREW 1.8x7.4
TORX PLUS 6IP
I0004
KEYPAD LIGHTGUIDE
I0008
UI-SHIELD ASSEMBLY
I0005
LCD AM 240 X 320
I0007
JOYSTICK HAT
I0009
EARPIECE+SPRING
I0006
DOMESHEET (A1)
I0010
A1=1 UT ENGINE MODULE
(NOT SUPPLIED)
I0010-I0012)
ENGINE MODULE (A1)
(NOT SUPPLIED)
I0011
RF-SHIELD LID (A1)
I0012
CAMERA MODULE
I0014
IHF SPEAKER (A2)
✻ I0015
IHF SPEAKER ADHESIVE (A2)
✻ I0016
A3=B-COVER ASSEMBLY
(I0018-I0024)
A2=1 GSM ANTENNA MODULE
(I0015-I0017)
MIC MOD+HOLDER (A3)
I0020
IHF LID (A2)
✻ I0017
CONN CHR DIA (A3)
I0022
SWITCH TACT 2DOME
(FUNCTION) (A3)
I0018
BATTERY COVER LATCH (A3)
I0021
SWITCH TACT 2DOME
(VOLUME) (A3)
I0019
BATTERY DECK (A3)
I0023 ✻
B-COVER (A3)
✻ I0024
TYPE LABEL
(LEVEL 3/4 ONLY)
I0013
A4=BATTERY COVER
ASSEMBLY
(I0026-I0027)
BATTERY CUSHION (A4)
I0027
CAMERA WINDOW
(INCLUSIVE ADHESIVE)
I0025
BATTERY COVER (A4)
✻ I0026

Ver. 1.0

● ELECTRO ● SILICON ● METAL ● PLASTIC ● PWB ● COVER

✻ = only available as assembly

Parts lists

Mechanical spare parts list

ITEM/ CIRCUIT REF.	Part Name
I0001	A-COVER ASSEMBLY WHITE
I0002	A-COVER LOGO BEZEL
I0003	MAIN KEYMAT
I0004	SCREW 1.8x7.4 TORX PLUS 6IP
I0005	UI-SHIELD ASSEMBLY
I0006	EARPIECE+SPRING
I0007	LCD AM 240 X 320
I0008	KEYPAD LIGHTGUIDE
I0009	JOYSTICK HAT
A1	**1 UT ENGINE MODULE (I0010 - I0012)**
I0010	DOMESHEET
I0011	ENGINE MODULE
I0012	RF-SHIELD LID
I0013	TYPE LABEL
I0014	CAMERA MODULE ,RM-170 only
A2	**1 GSM ANTENNA MODULE (I0015 - I0017)**
I0015	IHF SPEAKER
I0016	IHF SPEAKER ADHESIVE
I0017	IHF LID
A3	**B-COVER ASSEMBLY (I0018 - I0024)**
I0018	SWITCH TACT 2DOME (FUNCTION)
I0019	SWITCH TACT 2DOME (VOLUME)
I0020	MIC MOD+HOLDER
I0021	BATTERY COVER LATCH
I0022	CONN CHR DIA
I0023	BATTERY DECK
I0024	B-COVER
I0025	CAMERA WINDOW ,RM-170
	Camera Window blind ,RM-171
A4	**BATTERY COVER ASSEMBLY (I0026 - I0027)**
I0026	BATTERY COVER

ITEM/ CIRCUIT REF.	Part Name
I0027	BATTERY CUSHION

Component parts list

Component parts list 1ut_06a

Item	Side	Grid ref.		Type	Description and value		
R7506	Bot	B	17	0402R	Resistor 5% 63mW	10R	~
R7507	Bot	D	17	0402R	Resistor 5% 63mW	10R	~
R7508	Bot	B	16	0402R	Resistor 5% 63mW	10R	~
R2030	Bot	E	2	0402R	Resistor 5% 63mW	100R	~
R2307	Bot	D	15	0402R	Resistor 5% 63mW	100R	~
R2101	Bot	G	3	0402R	Resistor 5% 63mW	220R	~
R2404	Top	B	21	0402R	Resistor 5% 63mW	220R	~
R2415	Bot	E	22	0402R	Resistor 5% 63mW	220R	~
R2440	Bot	F	8	0402R	Resistor 5% 63mW	220R	~
R2441	Bot	F	8	0402R	Resistor 5% 63mW	220R	~
R3213	Bot	D	5	0402R	Resistor 5% 63mW	2k2	~
R7503	Bot	B	17	0402R	Resistor 5% 63mW	4k7	~
R7509	Bot	B	16	0402R	Resistor 5% 63mW	22k	~
R2200	Bot	E	11	0402R	Resistor 5% 63mW	100k	~
R3214	Bot	D	5	0402R	Resistor 5% 63mW	100k	~
R7502	Bot	D	18	0402R	CHIPRES 0W06 10K F 0402	10k	~
R2008	Bot	E	2	0404_RP	RES NETWORK 0W06 220K/120K J 0404	220k/ 120k	~

Item	Side	Grid ref.		Type	Description and value		
R2071	Bot	E	10	0402_NTH5	NTC RES 47K J B=4050+-3% 0402	47k	~
R2006	Bot	E	2	0405_2	VARISTOR ARRAY 2XVWM16V VC50 0405	2XVWM16V	~
R2070	Bot	F	16	0402_VAR	CHIP VARISTOR VWM14V VC50V 0402	14V/50V	~
R2102	Top	C	21	0402_VAR	CHIP VARISTOR VWM14V VC50V 0402	14V/50V	~
R2103	Top	C	21	0402_VAR	CHIP VARISTOR VWM14V VC50V 0402	14V/50V	~
R2119	Bot	D	19	0402_VAR	CHIP VARISTOR VWM14V VC50V 0402	14V/50V	~
R2120	Bot	D	20	0402_VAR	CHIP VARISTOR VWM14V VC50V 0402	14V/50V	~
R2416	Bot	F	22	0402_VAR	CHIP VARISTOR VWM14V VC50V 0402	14V/50V	~
R2420	Bot	A	17	0402_VAR	CHIP VARISTOR VWM14V VC50V 0402	14V/50V	~
R2421	Bot	A	17	0402_VAR	CHIP VARISTOR VWM14V VC50V 0402	14V/50V	~
R2422	Bot	A	17	0402_VAR	CHIP VARISTOR VWM14V VC50V 0402	14V/50V	~
R2423	Bot	H	17	0402_VAR	CHIP VARISTOR VWM14V VC50V 0402	14V/50V	~
R2424	Bot	H	17	0402_VAR	CHIP VARISTOR VWM14V VC50V 0402	14V/50V	~
R2425	Bot	H	17	0402_VAR	CHIP VARISTOR VWM14V VC50V 0402	14V/50V	~

Item	Side	Grid ref.		Type	Description and value		
R3210	Bot	D	4	0402_VAR	CHIP VARISTOR VWM14V VC50V 0402	14V/50V	~
C2102	Bot	G	3	0603C	CHIPCAP X5R 2U2 K 6V3 0603	2u2	6V3
C2200	Bot	G	11	0603C	CHIPCAP X5R 1U K 6V3 0603	1u0	6.3V
C2306	Bot	E	15	0603C	CHIPCAP X5R 1U K 6V3 0603	1u0	6.3V
C3300	Bot	G	16	0603C	CHIPCAP X5R 4U7 K 6V3 0603	4u7	6.3V
C3301	Bot	H	16	0603C	CHIPCAP X5R 4U7 K 6V3 0603	4u7	6.3V
C7503	Bot	B	17	0603C	CHIPCAP X5R 4U7 K 6V3 0603	4u7	6.3V
C7504	Bot	D	17	0603C	CHIPCAP X5R 4U7 K 6V3 0603	4u7	6.3V
C7506	Bot	B	16	0603C	CHIPCAP X5R 4U7 K 6V3 0603	4u7	6.3V
C7552	Bot	D	22	0402C	Chipcap +-0.25pF NP0	1p0	50V
C7501	Bot	C	17	0402C	Chipcap +-0.25pF NP0	2p7	50V
C7509	Bot	B	17	0402C	Chipcap +-0.25pF NP0	2p7	50V
C7520	Bot	C	20	0402C	Chipcap +-0.25pF NP0	3p3	50V
C6050	Bot	H	6	0402C	Chipcap +-0.25pF NP0	6p8	50V
C7553	Bot	D	21	0402C	Chipcap 5% NP0	10p	50V
C7554	Bot	D	22	0402C	Chipcap 5% NP0	10p	50V
C2404	Top	C	21	0402C	Chipcap 5% NP0	15p	50V
C2405	Top	G	21	0402C	Chipcap 5% NP0	15p	50V
C2250	Top	B	21	0402C	Chipcap 5% NP0	22p	50V
C2415	Bot	E	22	0402C	Chipcap 5% NP0	22p	50V
C2000	Bot	D	2	0402C	Chipcap 5% NP0	27p	50V
C3100	Bot	F	8	0402C	Chipcap 5% NP0	27p	50V
C2402	Top	F	21	0402C	Chipcap 5% NP0	56p	50V
C7550	Bot	D	22	0402C	Chipcap 5% NP0	56p	50V
C7551	Bot	D	22	0402C	Chipcap 5% NP0	56p	50V

Item	Side	Grid ref.		Type	Description and value		
C2030	Bot	E	2	0402C	Chipcap 5% X7R	270p	50V
C7513	Bot	B	16	0402C	Chipcap 5% X7R	820p	50V
C7508	Bot	B	17	0402C	Chipcap 5% NP0	18p	50V
C2202	Bot	E	10	0402C	Chipcap X7R 10% 50V 0402	1n0	50V
C2205	Bot	G	10	0402C	Chipcap X7R 10% 50V 0402	1n0	50V
C2206	Bot	F	10	0402C	Chipcap X7R 10% 50V 0402	1n0	50V
C3314	Bot	H	15	0402C	Chipcap X7R 10% 16V 0402	10n	16V
C7507	Bot	B	16	0402C	Chipcap X7R 10% 16V 0402	10n	16V
C3313	Bot	H	15	0402C	CHIPCAP X5R 1U K 6V3 0402	1u0	6.3V
C3315	Bot	H	16	0402C	CHIPCAP X5R 1U K 6V3 0402	1u0	6.3V
C2400	Top	F	21	0402C_H0.6	CHIPCAP X5R 100N M 16V 0402	100n	16V
C2401	Top	F	22	0402C_H0.6	CHIPCAP X5R 100N M 16V 0402	100n	16V
C2700	Bot	F	3	0402C_H0.6	CHIPCAP X5R 100N M 16V 0402	100n	16V
C3210	Bot	D	5	0402C_H0.6	CHIPCAP X5R 100N M 16V 0402	100n	16V
C3311	Bot	G	16	0402C_H0.6	CHIPCAP X5R 100N M 16V 0402	100n	16V
C3312	Bot	H	17	0402C_H0.6	CHIPCAP X5R 100N M 16V 0402	100n	16V
C7518	Bot	B	17	0402C_H0.6	CHIPCAP X5R 100N M 16V 0402	100n	16V
C7505	Bot	B	16	0402C	CHIPCAP X5R 1U5 K 4V 0402	1u5	4V
C7530	Bot	B	16	0402C	CHIPCAP X5R 1U5 K 4V 0402	1u5	4V
C2001	Bot	C	2	0603C_H0.95	CHIPCAP X5R 470N K 25V 0603	470n	25V
C2070	Bot	E	15	TANT_C_6.2X3.4_H1.7	CHIPTCAP 150U M 10V 6X3.2X1.5	150u_10V	10V

Item	Side	Grid ref.		Type	Description and value		
L2004	Bot	E	2	FERRITE_0402	FERRITE BEAD 0.6R 600R/100MHZ 0402	600R/ 100MHz	~
L2005	Bot	D	2	FERRITE_0402	FERRITE BEAD 0.6R 600R/100MHZ 0402	600R/ 100MHz	~
L2006	Bot	D	2	FERRITE_0402	FERRITE BEAD 0.6R 600R/100MHZ 0402	600R/ 100MHz	~
L2401	Top	F	22	FERRITE_0402	FERRITE BEAD 0.6R 600R/100MHZ 0402	600R/ 100MHz	~
L3300	Bot	G	16	FERRITE_0402	FERRITE BEAD 0.6R 600R/100MHZ 0402	600R/ 100MHz	~
L3302	Bot	D	16	FERRITE_0402	FERRITE BEAD 0.6R 600R/100MHZ 0402	600R/ 100MHz	~
L7502	Bot	B	17	FERRITE_0402	FERRITE BEAD 0.6R 600R/100MHZ 0402	600R/ 100MHz	~
L2000	Bot	D	2	0603_BLM	FERR.BEAD 220R/ 100M 2A 0R05 0603	220R/ 100MHz	~
Z7520	Bot	D	20	FERRITE_FBMJ1608	FERRITE BEAD 0R01 28R/100MHZ 0603	28R/ 100MHz	~
L2001	Bot	E	2	0405_2_MATSU	CHIP BEAD ARRAY 2X1000R 0405	2x1000R/ 100MHz	~
L2002	Bot	F	2	0405_2_MATSU	CHIP BEAD ARRAY 2X1000R 0405	2x1000R/ 100MHz	~
L2003	Bot	F	2	0405_2_MATSU	CHIP BEAD ARRAY 2X1000R 0405	2x1000R/ 100MHz	~
L2100	Top	B	21	0405_2_MATSU	CHIP BEAD ARRAY 2X1000R 0405	2x1000R/ 100MHz	~
L7504	Bot	C	18	0402L	CHIP COIL 22N J Q28/800M 0402	22nH	~
L7505	Bot	C	19	0402L	CHIP COIL 22N J Q28/800M 0402	22nH	~
L7500	Bot	C	18	0402L	CHIP COIL 12N J Q31/800M 0402	12nH	~
L7501	Bot	C	19	0402L	CHIP COIL 12N J Q31/800M 0402	12nH	~

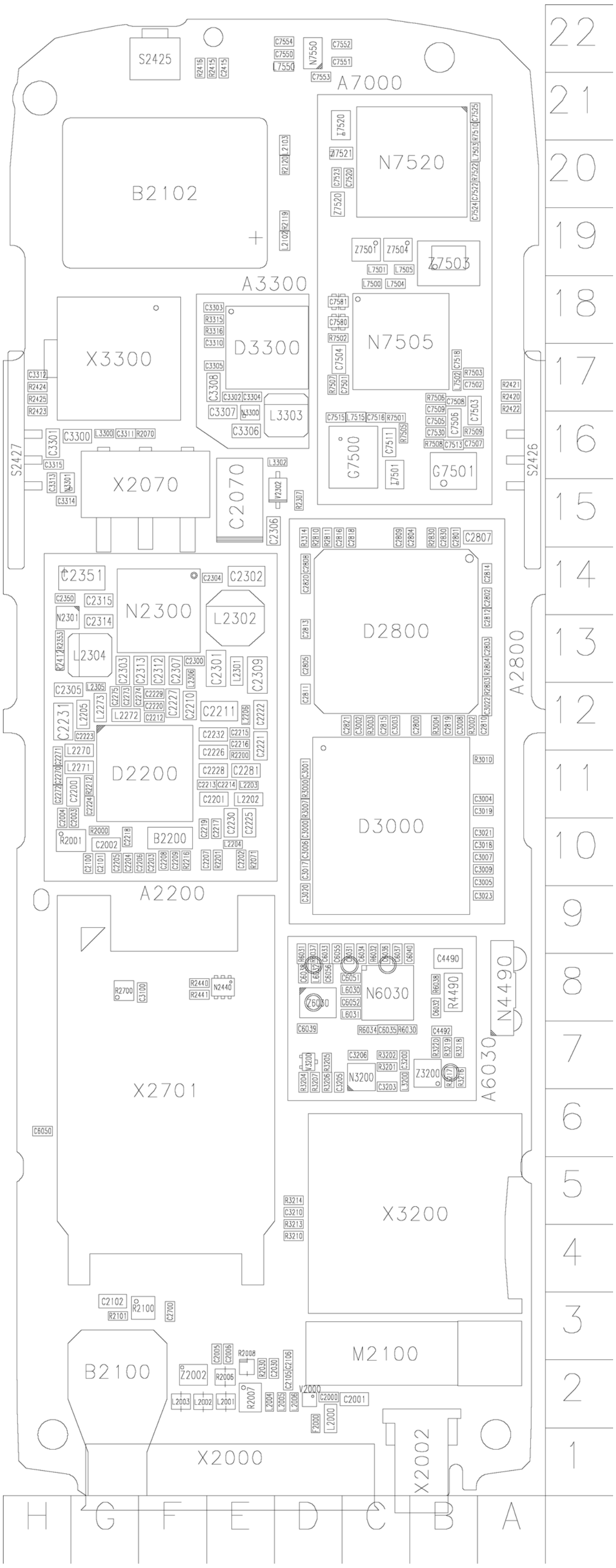
Item	Side	Grid ref.		Type	Description and value		
L7550	Bot	D	22	0402L_H0.45	CHIP COIL 4N7 +-0N1 Q29/1GHZ 0402	4n7H	~
L2102	Bot	D	19	0402CS	CHIP COIL WW 33N J Q25/250MHZ 260MA 0402	33nH	~
V2302	Bot	D	15	SOD323F	SCH DI 30V 2A SOD323F	~	~
R2700	Bot	G	8	uBGA8_1.47X1.47	ASIP SIM INTERFACE **LOW CAP**BGA8	~	~
V2000	Bot	D	2	BGA4_1.01X1.07	ASIP TVS BGA4	~	~
Z2002	Bot	F	2	BGA11	ASIP 4 LINES AUDIO FILTER BGA11	~	~
R2007	Bot	E	2	uBGA11_1.6X2.15	ASIP SILIC USB OTG / ESD BGA11	~	~
R2100	Bot	F	3	FLIP_CHIP_8_1.7X1.7	ASIP SINGLE ENDED MICROPHONE INTERF BGA8	~	~
Z2401	Top	F	21	FC6_1.27X0.86_P0.4	ASIP 2-LINES EMI/ESD FILTER BGA6	~	~
Z2402	Top	E	21	FC6_1.27X0.86_P0.4	ASIP 2-LINES EMI/ESD FILTER BGA6	~	~
Z2403	Top	E	21	FC6_1.27X0.86_P0.4	ASIP 2-LINES EMI/ESD FILTER BGA6	~	~
Z2405	Top	E	21	FC6_1.27X0.86_P0.4	ASIP 2-LINES EMI/ESD FILTER BGA6	~	~
Z2406	Top	E	21	FC6_1.27X0.86_P0.4	ASIP 2-LINES EMI/ESD FILTER BGA6	~	~
Z2407	Top	E	22	FC6_1.27X0.86_P0.4	ASIP 2-LINES EMI/ESD FILTER BGA6	~	~
Z2409	Top	C	9	FC6_1.27X0.86_P0.4	ASIP 2-LINES EMI/ESD FILTER BGA6	~	~
N2440	Bot	E	8	SOT_666	TRX2+RX4 PEMD9 N & P10K/47K 0W12 SOT666	~	~
N3301	Bot	H	15	USMD5_1.47X1.04_H0.675	VREG LP3985ITLX-2.8 NOPB USMD5	~	3V

Item	Side	Grid ref.		Type	Description and value		
N7550	Bot	D	22	SC70_6_FAIR	HIGH POWER SPDT RF SW SC70	~	~
N7520	Bot	B	20	RF9282E3.6	PW AMP RF9282E6.3 VDET SCREENED VERSION	~	~
N7505	Bot	C	18	TFBGA144	RFIC AHNE400A TRANSCEIVER TFBGA144	~	~
Z7501	Bot	C	19	FILTER_2.1X1.7_10P_H0.6	DUAL RX SAW FILTER 1800/1900MHZ 2016	1800/1900MHz	~
Z7521	Bot	D	20	FILTER_LFTC10N	CER FILT LFL181699TC1 2400-2483MHZ 1.6	2400-2483MHz	~
G2200	Top	B	21	BATTER_EECEP	RTC BACUP CAPAC 311 SIZE FOR 2.6V 4UAH	2.6V	~
V2410	Top	F	1	LED_CL270	LED WHITE 100MCD 20MA 0DEG	~	~
V2411	Top	C	1	LED_CL270	LED WHITE 100MCD 20MA 0DEG	~	~
V2440	Top	E	9	LED_SML_510	LED SML-512MWT86 MIN 14MCD	~	~
V2441	Top	E	7	LED_SML_510	LED SML-512MWT86 MIN 14MCD	~	~
F2000	Bot	D	2	0402_FUSE_AVX_H0.5	SM FUSE FF 2A 32V 0402	2.0A	~
S2425	Bot	F	22	SWITCH_EVQP7A01K	SM SW TACT SPST 12V SIDE KEY 2.2N	~	~
S2412	Top	E	8	SKRHAAE010	SM SW 5WAY NAVIGATION KEY	~	~
X3300	Bot	G	17	SOCKET_3D1141116_NS12_7F	SOCKET COMPACT ON-BOARD FOR SMIA85	~	~

Item	Side	Grid ref.		Type	Description and value		
X2070	Bot	F	15	LYNX_BATT_CONN_H7.0	SM BATTERY CONN 3POL SPR 12V 2A	~	~
X2000	Bot	E	1	SYSCON_MQ202_NK_14R3	SM SYSTEM CONNECTOR 14POL	~	~
X2400	Top	F	21	JST_R_JAVK_G_1_R3	SM CONN 2X12F P0.4 30V .3A PWB/PWB	~	~
X2701	Bot	F	6	SIM_CONN_P04_100157_001	SM SIM CONN 2X3POL P2.54 50V 0.5A	~	~
X3200	Bot	B	5	MOLEX_RSD_501885	CONN SMC TRANSFLASH MMC	~	~
X2002	Bot	B	1	CON_JACK_HR33NK_2DJA_2S	CONN DC-JACK 2.0MM 3POL SPR 90DEG	~	~
M2100	Bot	C	3	VIBRA_M_KHN4NX1RA	SMD VIBRA MOTOR 1.3V 80MA 9000RPM	~	~

Component layouts

Component layout - bottom


S2425
N7550
A7000
B2102
N7520
Z7503
A3300
X3300
D3300
N7505
L3303
S2427
X2070
C2070
G7500
G7501
S2426
A2800
C2351
N2300
C2302
L2302
L2304
D2800
C2301
C2309
C2231
C2211
D2200
D3000
B2200
A2200
N4490
N6030
R4490
X2701
N3200
Z3200
A6030
X3200
M2100
B2100
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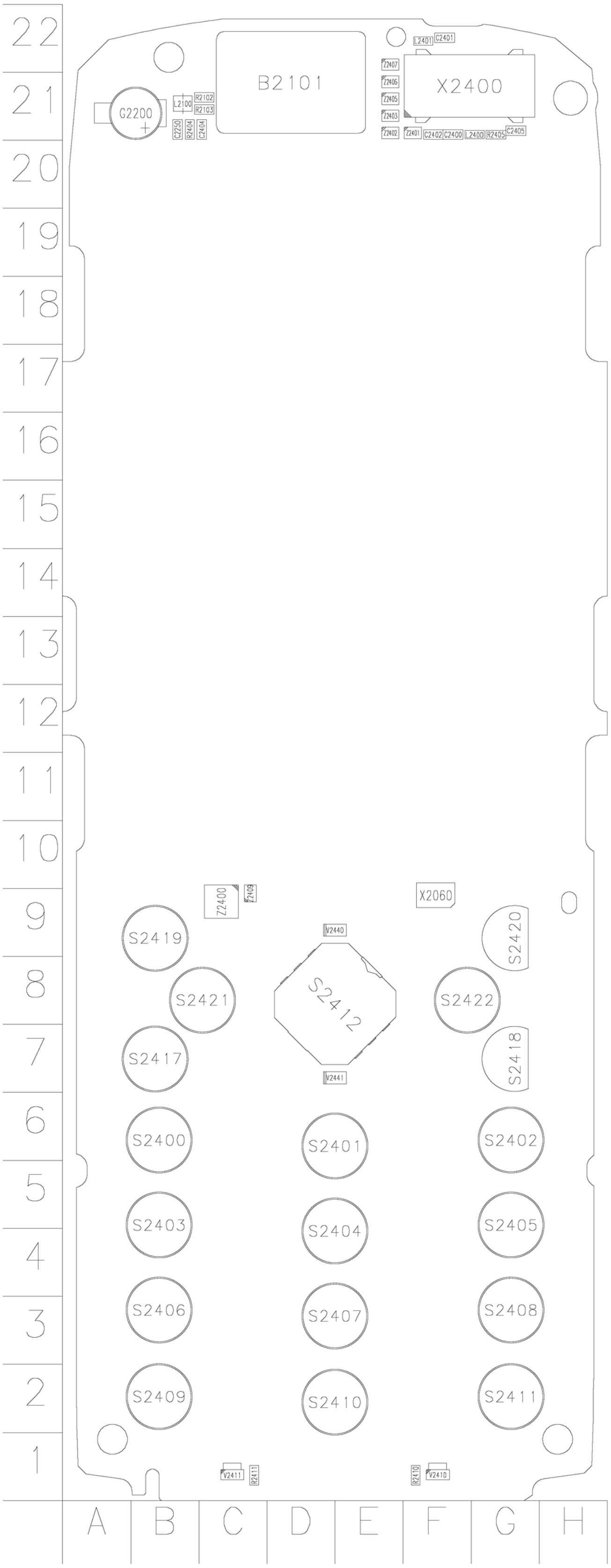
Component layout - top


22
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G2200
L2100
R2102
R2103
C2250
R2404
C2404
B2101
L2401
C2401
Z2407
Z2406
Z2405
Z2403
Z2402
Z2401
X2400
C2402
C2400
L2400
R2405
C2405
Z2400
Z2409
X2060
V2440
S2419
S2420
S2421
S2412
S2422
S2417
S2418
V2441
S2400
S2401
S2402
S2403
S2404
S2405
S2406
S2407
S2408
S2409
S2410
S2411
V2411
R2411
R2410
V2410

3 — Service Software Instructions

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Phoenix installation steps in brief

Prerequisites

Recommended hardware requirements:

- Computer processor: Pentium 700 MHz or higher
- RAM 256 MB
- Disk space 100-300 MB

Supported operating systems:

- *Windows 2000* Service Pack 3 or higher
- *Windows XP* Service Pack 1 or higher

Context

Phoenix is a service software for reprogramming, testing and tuning phones.

Phoenix installation contains:

- Service software support for all phone models included in the package
- Flash update package files for programming devices
- All needed drivers for:
  - PKD-1 (DK2) dongle
  - DKU-2 USB cable

Note: Separate installation packages for flash update files and drivers are also available, but it is not necessary to use them unless there are updates between *Phoenix* service software releases. If separate update packages are used, they should be used after *Phoenix* and data packages have been installed.

The phone model specific data package includes all changing product specific data:

- Product software binary files
- Files for type label printing
- Validation file for the faultlog repair data reporting system
- All product specific configuration files for *Phoenix* software components

Note: *Phoenix* and phone data packages should only be used as complete installation packages. Uninstallation should be made from the *Windows* Control Panel.

To use *Phoenix*, you need to:

Steps

1. Connect a PKD-1 (DK2) dongle to the computer parallel port.
2. Install *Phoenix*.
3. Install the phone-specific data package.
4. Configure users.
5. Manage connection settings (depends on the tools you are using).

If you use FPS-8:	• Update FPS-8 software • Activate FPS-8

If you use FPS-10:	• Update FPS-10 software **Note:** There is no need to activate FPS-10. • Activate SX-4 smart card, if you need tuning and testing functions. **Note:** When FPS-10 is used only for product software updates, SX-4 smart card is not needed.

Results

Phoenix is ready to be used with FPS-8 or FPS-10 flash prommers and other service tools.

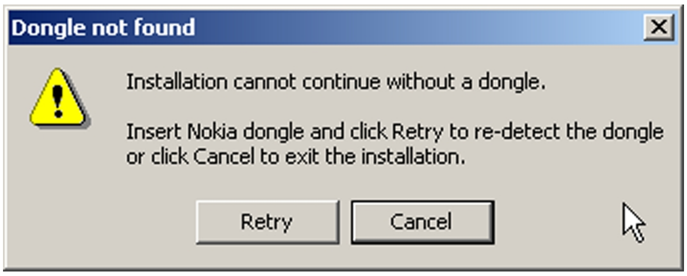
Installing *Phoenix*

Prerequisites

- Check that a dongle is attached to the parallel port of your computer.
- Download the *Phoenix* installation package (for example, *phoenix_service_sw_2004_39_x_xx.exe*) to your computer (in *C:|TEMP*, for instance).
- Close all other programs.
- Depending on your operating system, administrator rights may be required to install *Phoenix*.
- If uninstalling or rebooting is needed at any point, you will be prompted by the InstallShield program.

Context

At some point during the installation procedure, you may get the following message:



Installation cannot continue without a dongle.

Insert Nokia dongle and click Retry to re-detect the dongle or click Cancel to exit the installation.

Figure 2 Dongle not found

This may be a result of a defective or too old PKD-1 dongle.

Check the COM/parallel ports used. After correcting the problem, you can restart the installation.

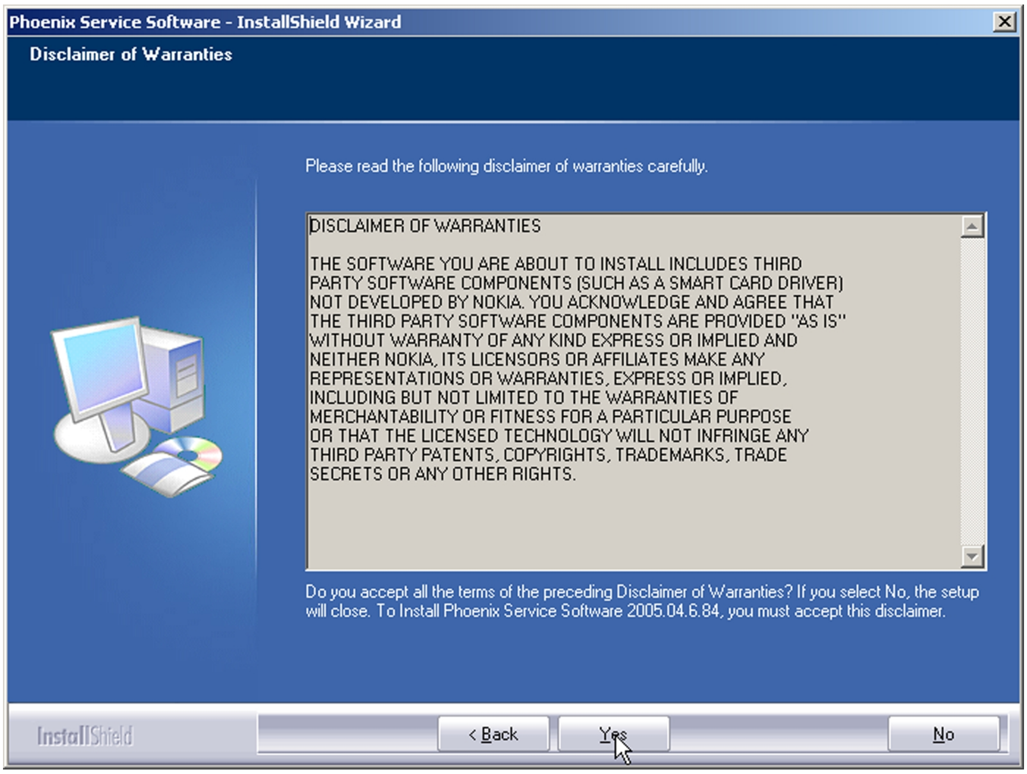
For more detailed information, please refer to *Phoenix* Help files.

> **Tip:** Each feature in *Phoenix* has its own Help function, which can be activated while running the program. Press the **F1** key or the feature's **Help** button to activate a Help file.

Steps

1. To start the installation, run the application file (for example,*phoenix_service_sw_2004_39_x_xx.exe*).
2. In the *Welcome* dialogue, click **Next**.

3. Read the disclaimer text carefully and click **Yes**.



Disclaimer of Warranties

Please read the following disclaimer of warranties carefully.

DISCLAIMER OF WARRANTIES

THE SOFTWARE YOU ARE ABOUT TO INSTALL INCLUDES THIRD PARTY SOFTWARE COMPONENTS (SUCH AS A SMART CARD DRIVER) NOT DEVELOPED BY NOKIA. YOU ACKNOWLEDGE AND AGREE THAT THE THIRD PARTY SOFTWARE COMPONENTS ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND EXPRESS OR IMPLIED AND NEITHER NOKIA, ITS LICENSORS OR AFFILIATES MAKE ANY REPRESENTATIONS OR WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR THAT THE LICENSED TECHNOLOGY WILL NOT INFRINGE ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADEMARKS, TRADE SECRETS OR ANY OTHER RIGHTS.

Do you accept all the terms of the preceding Disclaimer of Warranties? If you select No, the setup will close. To Install Phoenix Service Software 2005.04.6.84, you must accept this disclaimer.

Figure 3 Disclaimer text

4. Choose the destination folder.

   The default folder *C:|ProgramFiles|Nokia|Phoenix* is recommended.

5. To continue, click **Next.**

   To choose another location, click **Browse** (not recommended).

6. Wait for the components to be copied.

   The progress of the installation is shown in the *Setup Status* window.

7. Wait for the drivers to be installed and updated.

   The process may take several minutes to complete.

   If the operating system does not require rebooting, the PC components are registered right away.

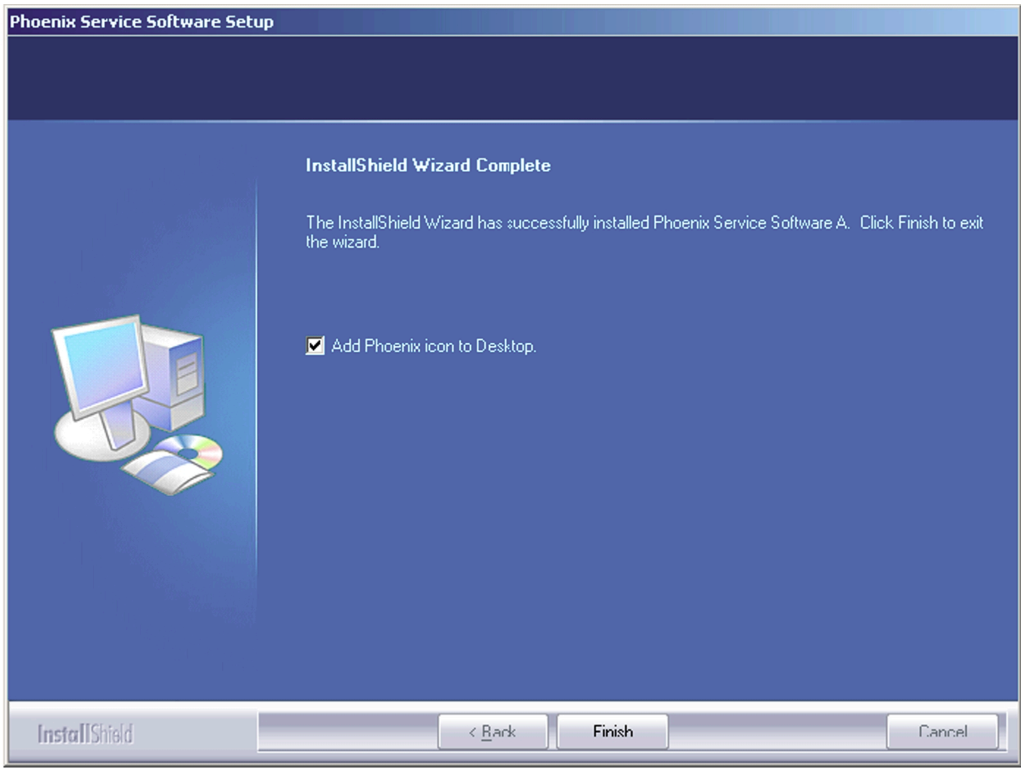
   If the operating system requires restarting your computer, the Install Shield Wizard will notifies about it.

   Select **Yes...** to reboot the PC immediately or **No...** to reboot the PC manually afterwards.

   After the reboot, all components are registered.

   Note: *Phoenix* does not work, if the components have not been registered.

8. To end the installation, click **Finish**.



Phoenix Service Software Setup

InstallShield Wizard Complete

The InstallShield Wizard has successfully installed Phoenix Service Software A. Click Finish to exit the wizard.

☑ Add Phoenix icon to Desktop.

Figure 4 InstallShield Wizard Complete

Next actions

After the installation, *Phoenix* can be used after:

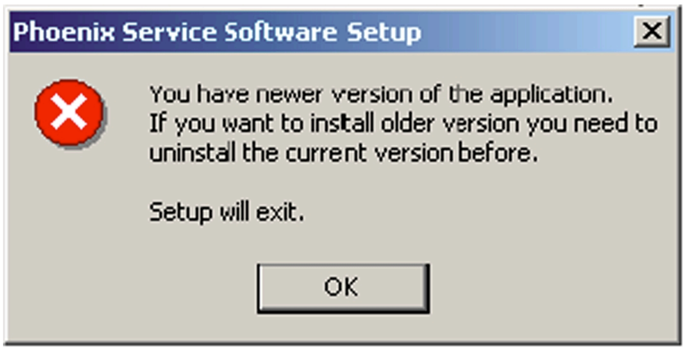
- installing phone model specific data package for *Phoenix*
- configuring users and connections

FPS-8 and FPS-10 flash prommers can be used after updating their flash update package files.

Updating *Phoenix* installation

Context

- If you already have the *Phoenix* service software installed on your computer, you need to update the software when new versions are released.
- To update *Phoenix*, you need to follow the same steps as when installing it for the first time.
- When you are updating, for example, from version **a14_2004_16_4_47** to **a15_2004_24_7_55**, the update will take place automatically without uninstallation.
- Always use the latest available versions of both *Phoenix* and the phone-specific data package. Instructions can be found in the phone model specific Technical Bulletins and phone data package *readme.txt* files (shown during installation).
- If you try to update *Phoenix* with the same version you already have (for example, **a15_2004_24_7_55** to **a15_2004_24_7_55**), you are asked if you want to uninstall the existing version. In this case you can choose between a total uninstallation or a repair installation in a similar way when choosing to uninstall the application from the *Windows* Control Panel.
- If you try to install an older version (for example, downgrade from **a15_2004_24_7_55** to **a14_2004_16_4_47**), installation will be interrupted.



You have newer version of the application.
If you want to install older version you need to uninstall the current version before.

Setup will exit.

Figure 5 Installation interrupted

- Always follow the instructions on the screen.

Steps

1. Download the installation package to your computer hard disk.
2. Close all other programs.
3. Run the application file (for example, *phoenix_service_sw_2004_39_x_xx.exe*).

Results

A new *Phoenix* version is installed and driver versions are checked and updated.

Uninstalling *Phoenix*

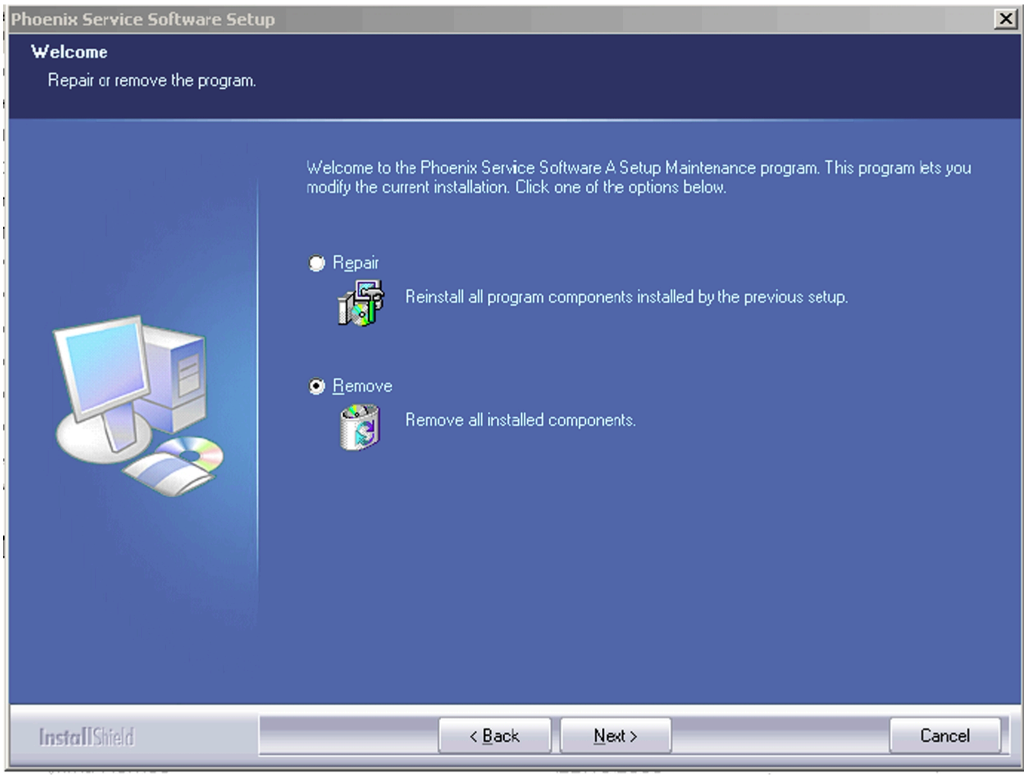
Context

You can uninstall *Phoenix* service software manually from the *Windows* Control Panel.

Steps

1. Open the **Windows Control Panel**, and choose **Add/Remove Programs**.

2. To uninstall *Phoenix*, choose **Phoenix Service Software→Change/Remove→Remove** .



Phoenix Service Software Setup

Welcome

Repair or remove the program.

Welcome to the Phoenix Service Software A Setup Maintenance program. This program lets you modify the current installation. Click one of the options below.

○ Repair

Reinstall all program components installed by the previous setup.

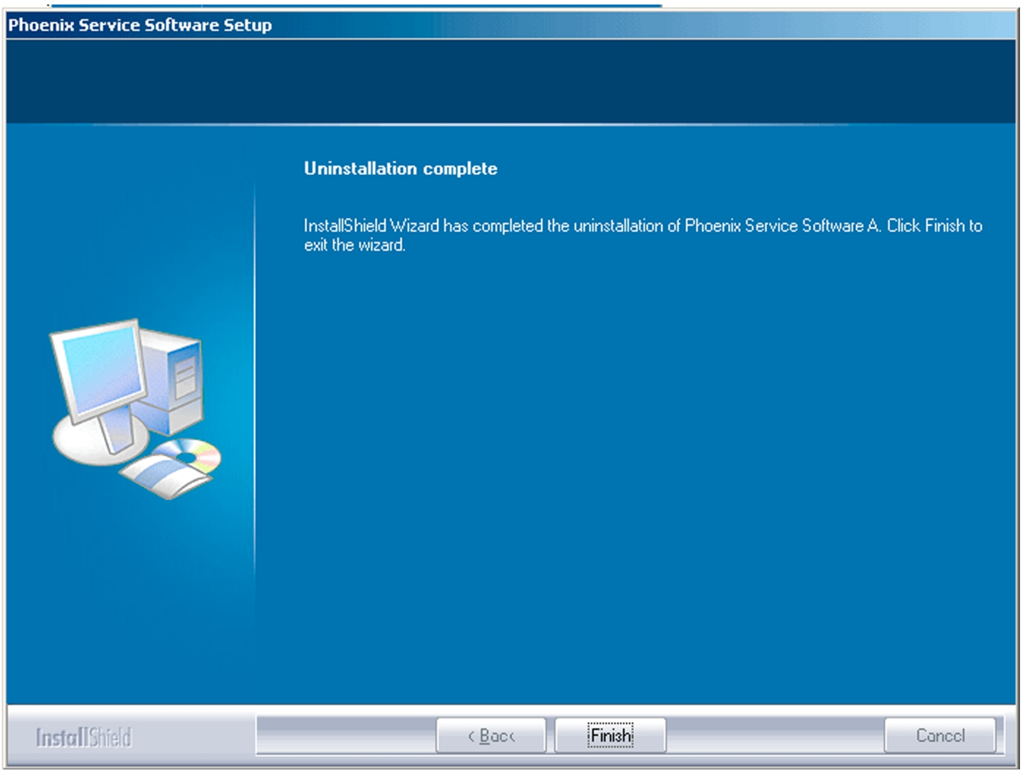
● Remove

Remove all installed components.

Figure 6 Remove program

The progress of the uninstallation is shown.

3. If the operating system does not require rebooting, click **Finish** to complete.



Phoenix Service Software Setup

Uninstallation complete

InstallShield Wizard has completed the uninstallation of Phoenix Service Software A. Click Finish to exit the wizard.

Figure 7 Finish uninstallation

If the operating system requires rebooting, InstallShield Wizard will notify you. Select **Yes...** to reboot the PC immediately and **No...** to reboot the PC manually afterwards.

Repairing *Phoenix* installation

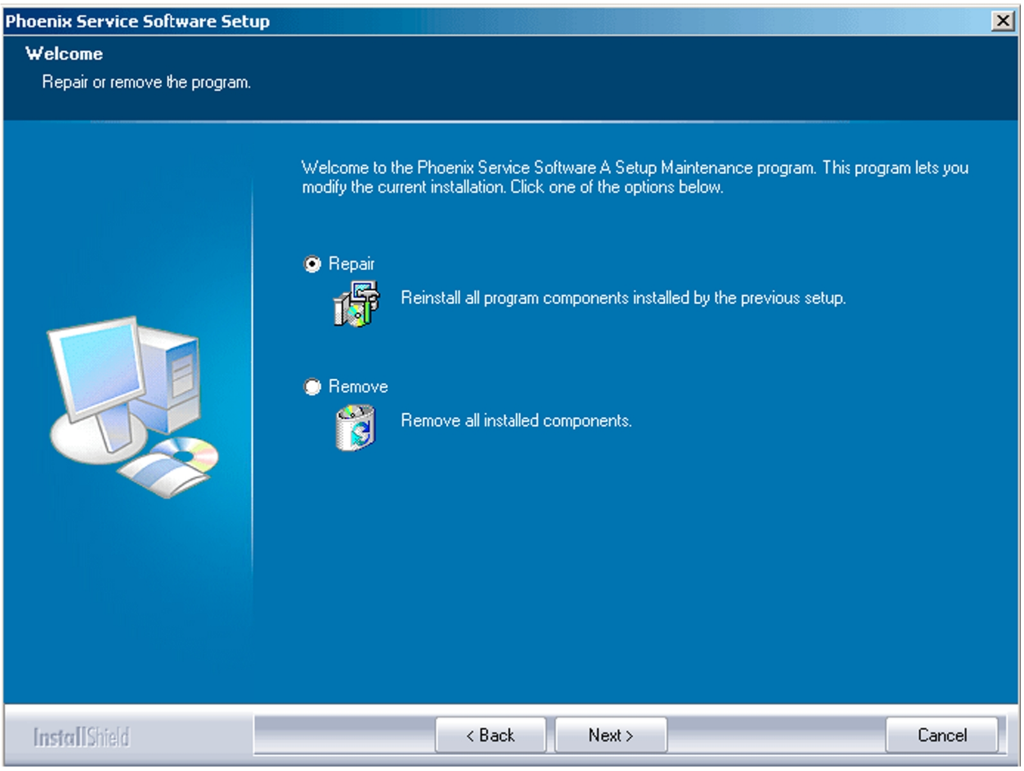
Context

If you experience any problems with the service software or suspect that files have been lost, use the repair function before completely reinstalling *Phoenix*.

> **Note:** The original installation package (for example, *phoenix_service_sw_a15_2004_24_7_55.exe*) must be found on your PC when you run the repair setup.

Steps

1. Open **Windows Control Panel→Add/Remove Programs** .
2. Choose **Phoenix Service Software→Change/Remove** .
3. In the following view, select **Repair**.



Welcome to the Phoenix Service Software A Setup Maintenance program. This program lets you modify the current installation. Click one of the options below.

● Repair
Reinstall all program components installed by the previous setup.

○ Remove
Remove all installed components.

Figure 8 Repair program

Phoenix reinstalls components and registers them.

The procedure is the same as when updating *Phoenix*.

4. To complete the repair, click **Finish**.

Phone data package overview

Each product has its own data package (DP). The product data package contains all product-specific data files to make the Phoenix service software and tools usable with a certain phone model.

The phone data package contains the following:

- Product software binary files

- Files for type label printing
- Validation file for the fault log repair data reporting system
- All product-specific configuration files for Phoenix software components

Data files are stored in **C:\Program Files\Nokia\Phoenix** (default).

Installing phone data package

Prerequisites

- A phone-specific data package contains all data required for the *Phoenix* service software and service tools to be used with a certain phone model.
- Check that a dongle is attached to the parallel port of your computer.
- Install *Phoenix* service software.
- Download the installation package (for example, *XX-XX_dp_EA_v_1_0.exe*) to your computer (for example, in C:\TEMP).
- Close all other programs.

(XX-XX = type designator of the product)

If you already have *Phoenix* installed on your computer, you will need to update it when a new version is released.

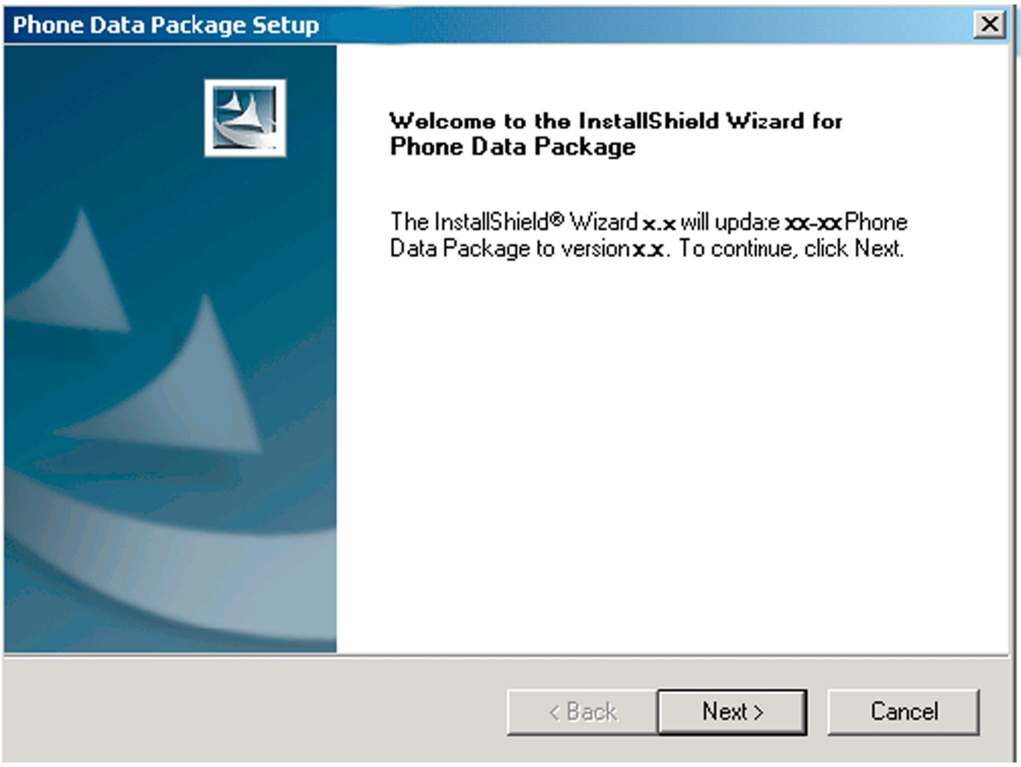
> **Note:** Often *Phoenix* and the phone-specific data package come in pairs, meaning that a certain version of *Phoenix* can only be used with a certain version of a data package. Always use the latest available versions of both. Instructions can be found in phone-specific Technical Bulletins and *readme.txt* files of data packages.

Steps

1. To start the installation, run the application file (for example, *XX-XX_dp_EA_ v_1_0.exe*),

   Wait for the installation files to be extracted.

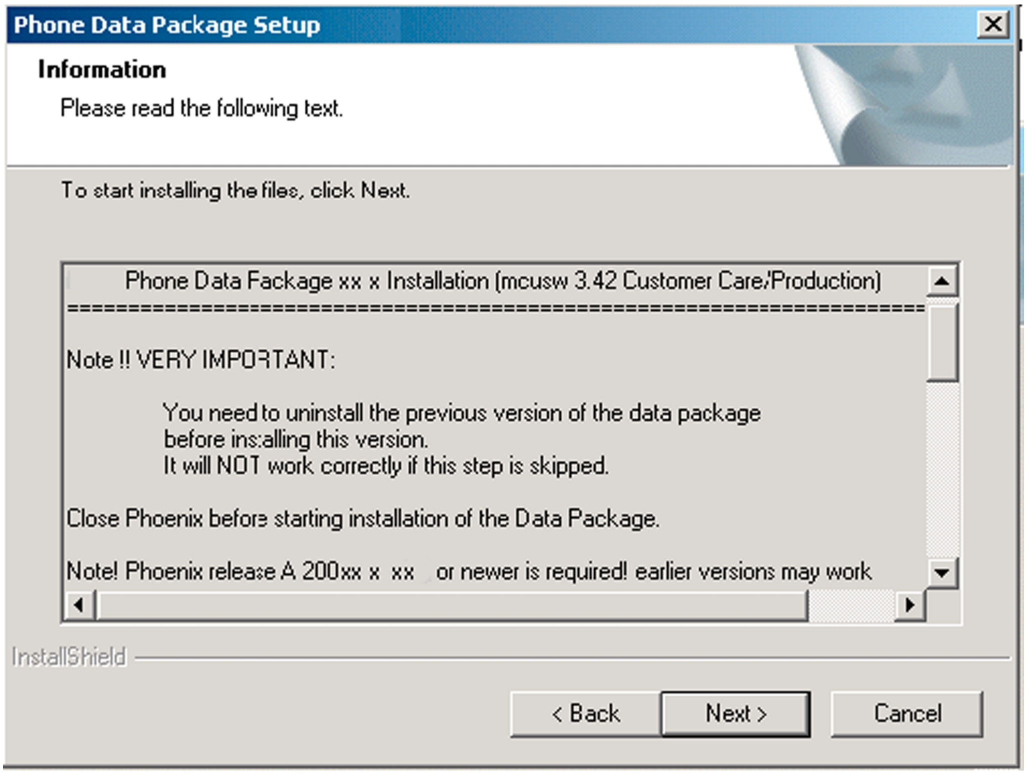
2. Click **Next**.



Welcome to the InstallShield Wizard for Phone Data Package

The InstallShield® Wizard x.x will update xx-xx Phone Data Package to version x.x. To continue, click Next.

3. In the following view you can see the contents of the data package. Read the text carefully. There is information about the *Phoenix* version required with this data package.



Information

Please read the following text.

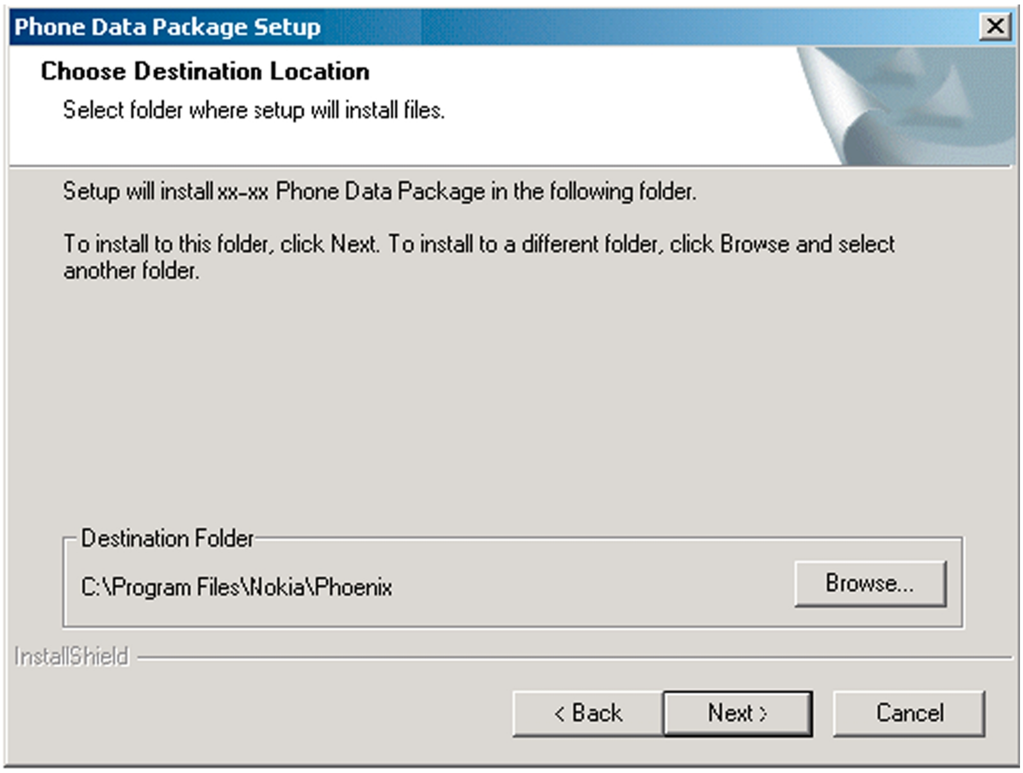
To start installing the files, click Next.

```
      Phone Data Package xx x Installation (mcusw 3.42 Customer Care/Production)
==========================================================================

Note !! VERY IMPORTANT:

        You need to uninstall the previous version of the data package
        before installing this version.
        It will NOT work correctly if this step is skipped.

Close Phoenix before starting installation of the Data Package.

Note! Phoenix release A 200xx x  xx    or newer is required! earlier versions may work
```

Figure 9 Data package setup information

4. To continue, click **Next**.

5. Choose the destination folder, and click **Next** to continue.


Phone Data Package Setup

Choose Destination Location

Select folder where setup will install files.

Setup will install xx-xx Phone Data Package in the following folder.

To install to this folder, click Next. To install to a different folder, click Browse and select another folder.

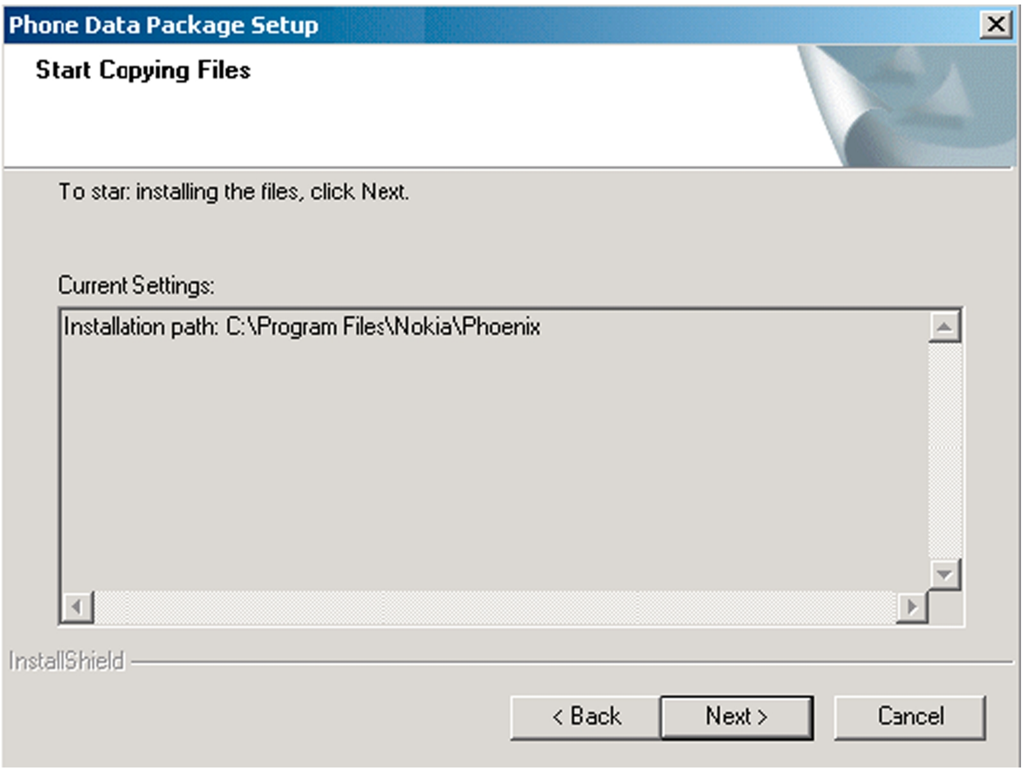
Destination Folder

C:\Program Files\Nokia\Phoenix

Figure 10 Data package destination folder

The InstallShield Wizard checks where *Phoenix* is installed, and the directory is shown.

6. To start copying the files, click **Next**.


Phone Data Package Setup

Start Copying Files

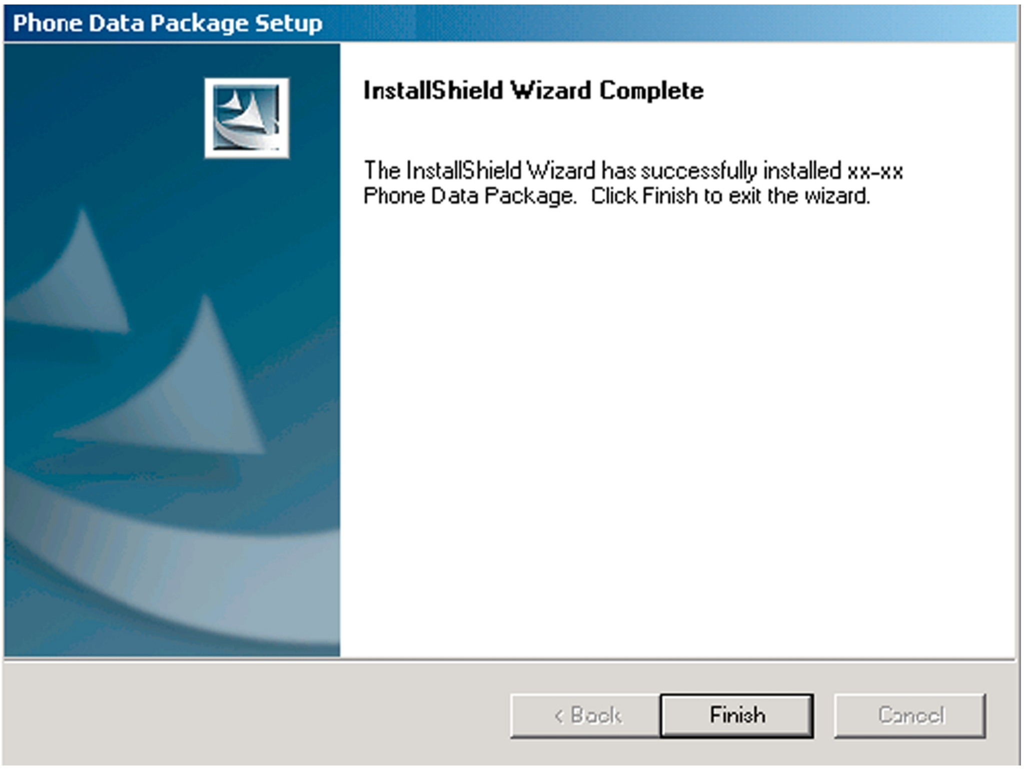
To start installing the files, click Next.

Current Settings:

Installation path: C:\Program Files\Nokia\Phoenix

Phone model specific files are installed. Please wait.

7. To complete the installation, click **Finish**.



InstallShield Wizard Complete

The InstallShield Wizard has successfully installed xx-xx Phone Data Package. Click Finish to exit the wizard.

Figure 11 InstallShield Wizard Complete

Next actions

Phoenix can be used for flashing phones and printing type labels after:

- Configuring users
- Managing connections

FPS-8 and FPS-10 can be used after updating their flash update package files.

Uninstalling phone data package

Context

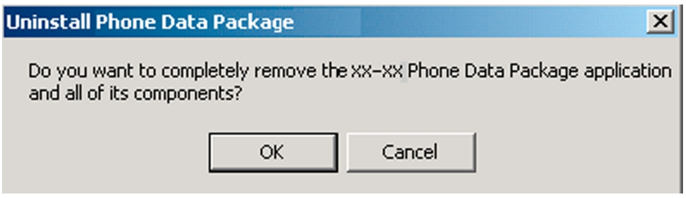
There is no need to uninstall an older version of a data package, unless instructions to do so are given in the *readme.txt* file of the data package and bulletins related to the release.

Please read all related documents carefully.

Steps

1. Locate the data package installation file (e.g. *XX-XX_dp_EA_v_1_0.exe*) from your computer.
2. To start the uninstallation procedure, double-click the data package installation file.

3. To uninstall the data package, click **OK** or to interrupt the uninstallation, click **Cancel**.

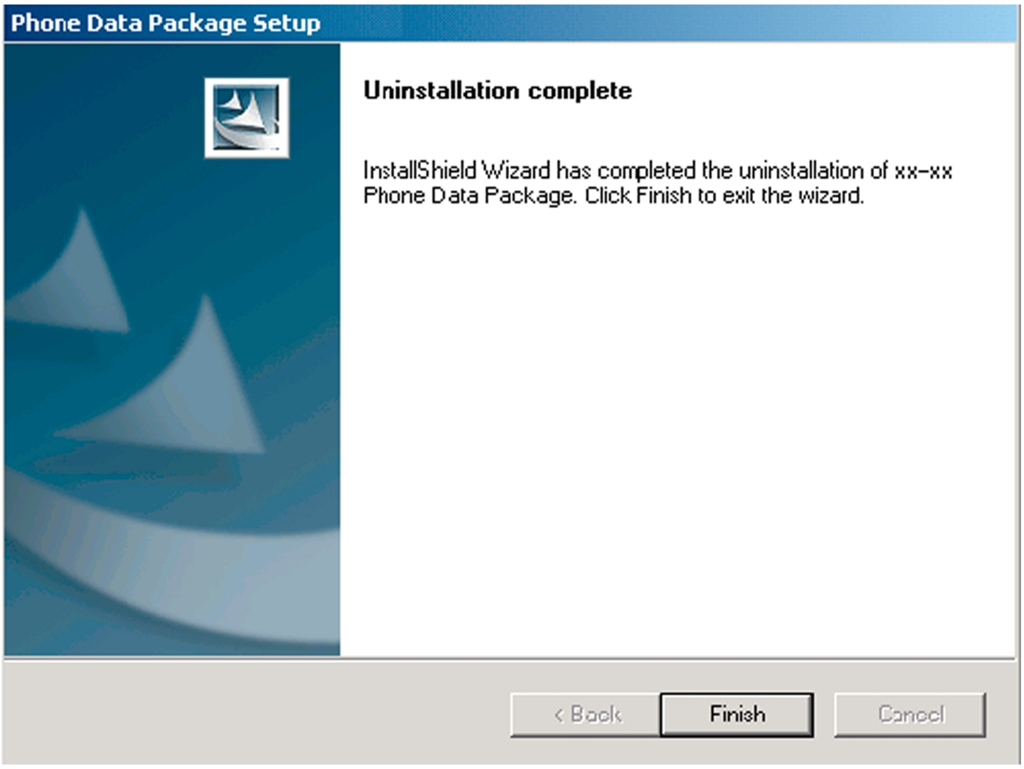


Uninstall Phone Data Package

Do you want to completely remove the xx-xx Phone Data Package application and all of its components?

Figure 12 Uninstalling phone data package

4. When the data package is uninstalled, click **Finish**.



Phone Data Package Setup

Uninstallation complete

InstallShield Wizard has completed the uninstallation of xx-xx Phone Data Package. Click Finish to exit the wizard.

Figure 13 Finishing data package uninstallation

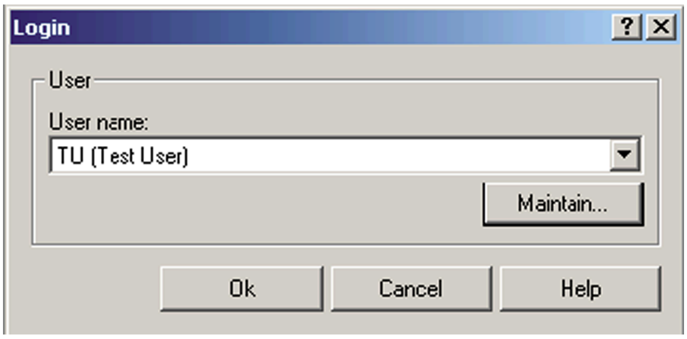
Alternative steps

- You can also uninstall the data package manually from **Control Panel→Add/Remove Programs→xx-xx* Phone Data Package** . (*= type designator of the phone).

Configuring users in *Phoenix*

Steps

1. Start *Phoenix* service software, and log in.



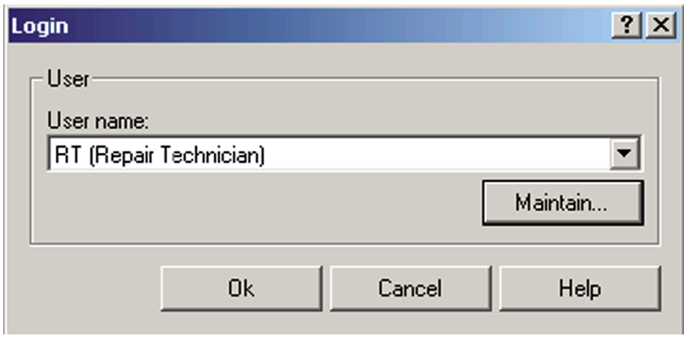
User name: TU (Test User)

Figure 14 Phoenix login

If the user ID is already configured, select s/he from the *User name* drop-down list, and click **OK**.

2. To add a new user, or to edit existing ones, click **Maintain**.
3. To add a new user, click **New**.
4. Type in the name and initials of the user, and click **OK**.

   The user is added to the user name list.
5. Select the desired user from the *User name* drop-down list, and click **OK**.



User name: RT (Repair Technician)

Figure 15 New user configured

Managing connections in *Phoenix*

Context

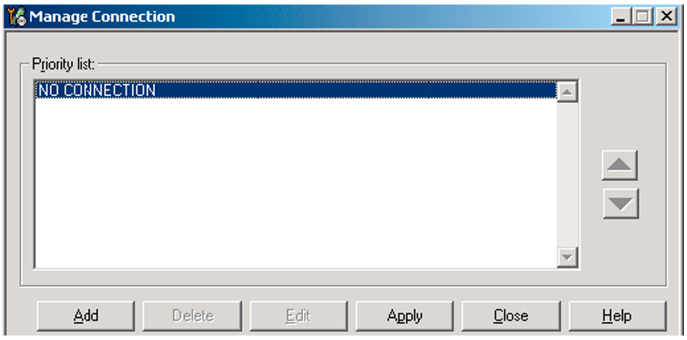
With the **Manage Connections** feature you can edit and delete existing connections or create new ones.

> **Note:** After choosing the desired connection, and connecting the phone to a PC for the first time, allow the PC to install the USB device drivers first. Please note that this may take some time to complete.
>
> If there are problems after the driver installation, check that the USB connection is active from the **Windows Control Panel**. If the problem persists, contact the local PC support.

Steps

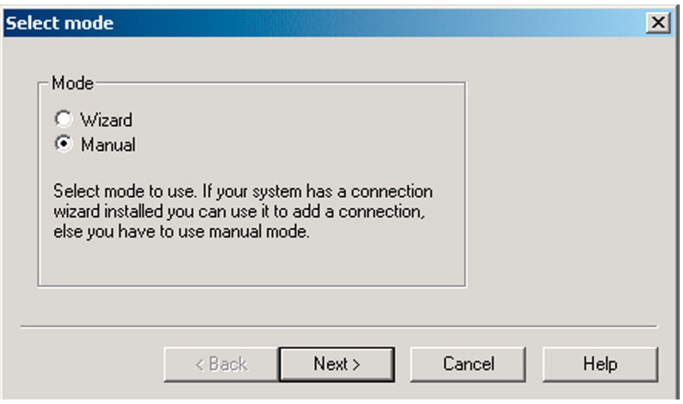
1. Start *Phoenix*, and log in.
2. Choose **File→Manage Connections...** .

3. To add a new connection, click **Add**.



4. Select **Manual** mode, and click **Next** to continue.

   If you want to create the connection using the Connection Wizard, connect the tools and a phone to your PC. The wizard will automatically try to configure the correct connection.



Select mode to use. If your system has a connection wizard installed you can use it to add a connection, else you have to use manual mode.

Figure 16 Select mode: Manual

i For an FPS-10 flash prommer with a **USB Connection**, choose the following connection settings:

- Media: **FPS-10 USB**
- DEVICE_INDEX: **0**
- SERIAL_NUM: See Serial No from the label attached to the bottom of FPS-10
- ACTIVE_MEDIA: **USB**

ii For an FPS-10 flash prommer with a **LAN connection**, choose the following connection settings:

- Media: **FPS-10 TCP/IP**
- NET_SERV_NAME: Click **Scan...**. Choose your own FPS-10 device based on the correct MAC address. See Serial No from the label attached to the bottom of your FPS-10.
- PORT_NUM: Use the default value, and click **Next**.
- PROTOCOL_FAMILY: Use the default value, and click **Next**.
- SOCKET TYPE: Use the default value, and click **Next**.
- TX_BUFFER_SIZE: Use the default value, and click **Next**.
- RX_BUFFER_SIZE: Use the default value, and click **Next**.

iii For an FPS-8 flash prommer, choose the following connection settings:

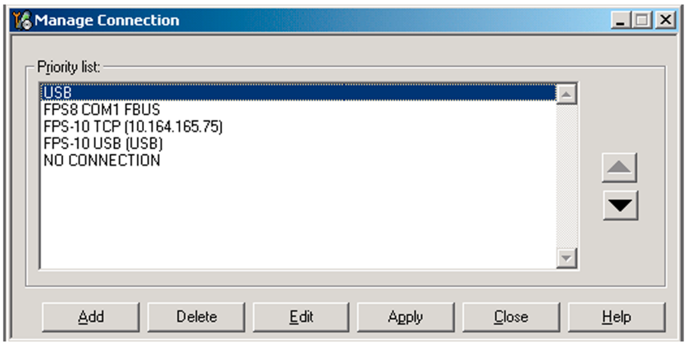
- Media: FPS-8
- PORT_NUM: COM Port where FPS-8 is connected
- COMBOX_DEF_MEDIA: **FBUS**

iv For a plain **USB connection**, choose the following connection settings:

Note: First connect the DKU-2 USB cable between the PC USB port and phone.

- Media: USB

5. To complete the configuration, click **Finish**.
6. Click the connection you want to activate. Use the up/down arrows located on the right hand side to move it on top of the list, then click **Apply**.



Priority list:

USB
FPS8 COM1 FBUS
FPS-10 TCP (10.164.165.75)
FPS-10 USB (USB)
NO CONNECTION

Figure 17 Connections list

The connection is activated, and it can be used after closing the *Manage Connection* window.

The connection information is shown at the right hand bottom corner of the screen.

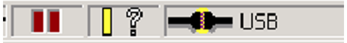
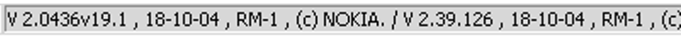


Figure 18 Connection information

7. To use the connection, connect the phone to your PC with correct service tools. Make sure the phone is switched on, and then choose **File→Scan Product** .

Results

The product support module information appears in the status bar:



V 2.0436v19.1 , 18-10-04 , RM-1 , (c) NOKIA. / V 2.39.126 , 18-10-04 , RM-1 , (c)

Figure 19 Product support module information (example from RM-1)

Installing flash support files for FPS-8 and FPS-10

Prerequisites

- Install *Phoenix* service software.
- Install phone model specific data package for *Phoenix*.
- If you want to update the flash support files, they are delivered in the same installation package with *Phoenix* or newer *Phoenix* packages beginning from December 2004.

  In case you want to update the MCU files, install the latest data package (see Technical Bulletins for information on the latest one).

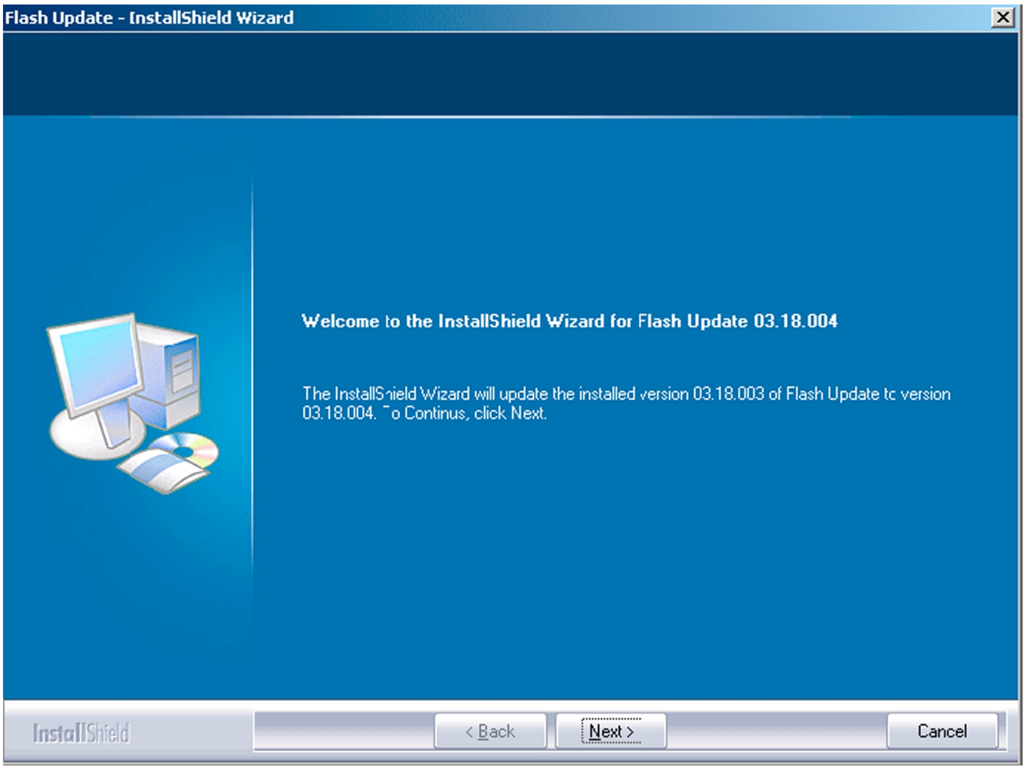
  Normally, it is enough to install *Phoenix* and the phone-specific data package because the installation always includes the latest flash update package files for FPS-8 and FPS-10.
- A separate installation package for flash support files is available. The files can be updated according to these instructions, if updates appear between *Phoenix* data package releases.

Context

If you are not using a separate installation package, you can skip this section and continue with "Updating FPS-8 and FPS-10 flash prommer software" (page 3–22) after installing a new phone data package.

Steps

1. To begin the installation, double-click the flash update file (for example, *flash_update_03_183_0014.exe*).



Welcome to the InstallShield Wizard for Flash Update 03.18.004

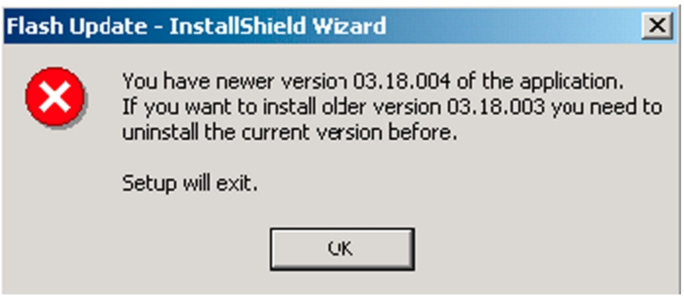
The InstallShield Wizard will update the installed version 03.18.003 of Flash Update to version 03.18.004. To Continue, click Next.

Figure 20 Flash update welcome dialog

   If the same version of the flash update package already exists, and you want to reinstall it, the previous package is first uninstalled.

   Restart installation again after the uninstallation.

2. If you try to downgrade the existing version to older ones, the setup will be aborted. If there is a need to downgrade the version, uninstall newer files manually from the **Windows Control Panel**, and then rerun the installation.



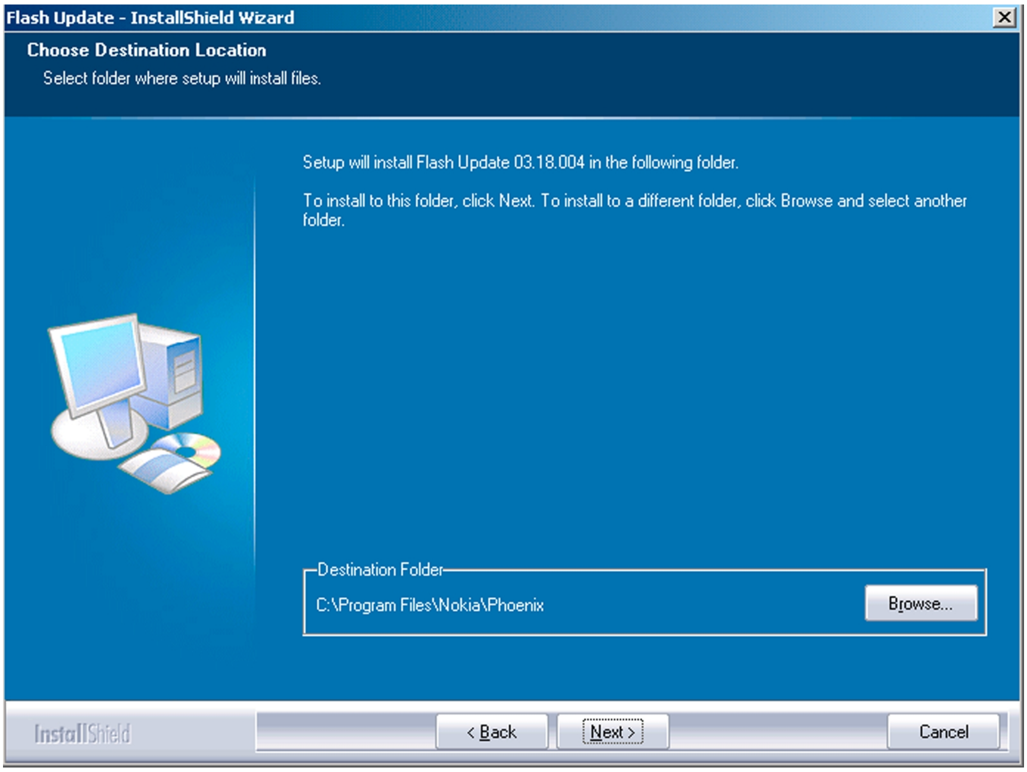
You have newer version 03.18.004 of the application.
If you want to install older version 03.18.003 you need to uninstall the current version before.

Setup will exit.

Figure 21 Flash installation interrupted

   If an older version exists on your PC and it needs to be updated, click **Next** to continue installation.

3. It is recommended to install the files to the default destination folder *C:|Program Files|Nokia|Phoenix*. To continue, click **Next**.



Flash Update - InstallShield Wizard

Choose Destination Location

Select folder where setup will install files.

Setup will install Flash Update 03.18.004 in the following folder.

To install to this folder, click Next. To install to a different folder, click Browse and select another folder.

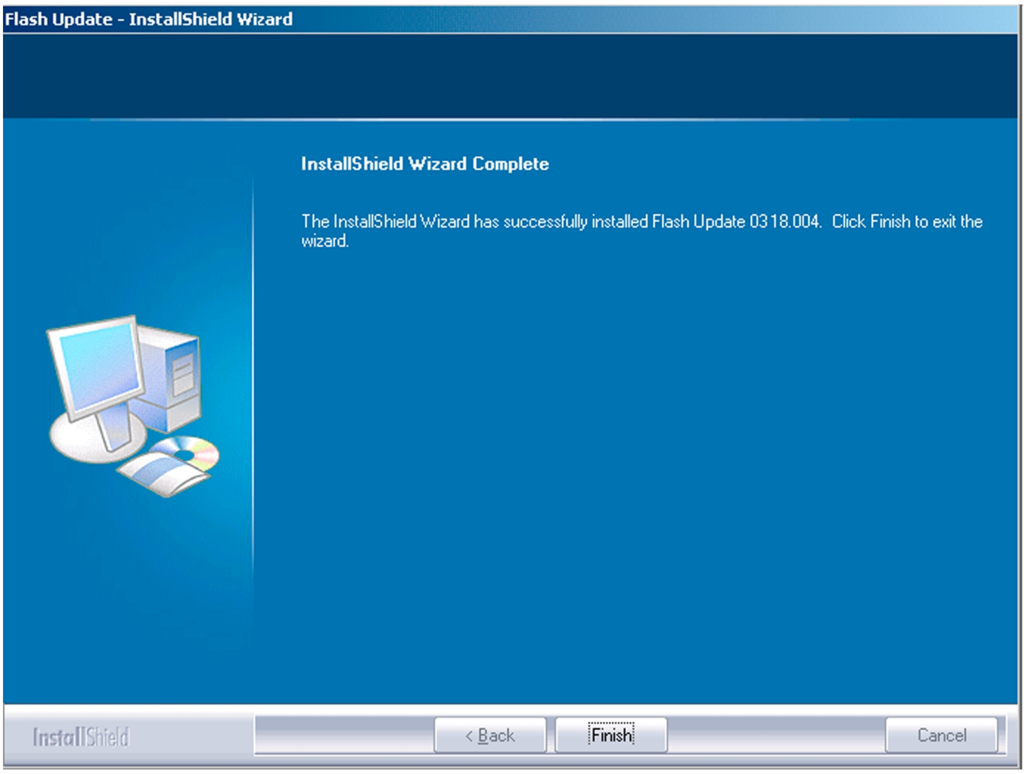
Destination Folder

C:\Program Files\Nokia\Phoenix

Figure 22 Flash destination folder

When installing the flash update files for the first time, you may choose another location by selecting **Browse** (not recommended).

4. To complete the installation procedure, click **Finish** .



Flash Update - InstallShield Wizard

InstallShield Wizard Complete

The InstallShield Wizard has successfully installed Flash Update 0318.004. Click Finish to exit the wizard.

Figure 23 Finish flash update

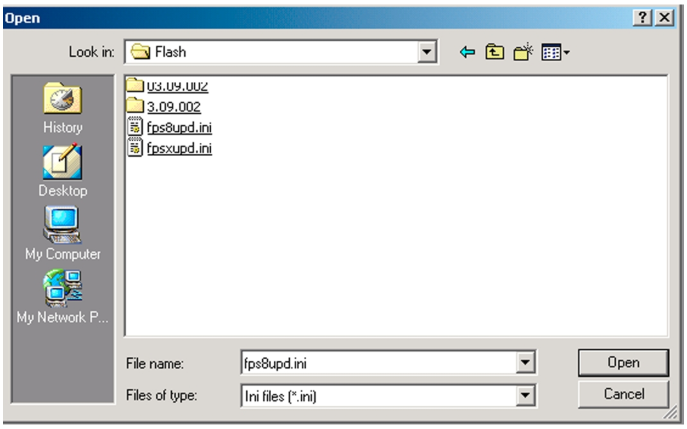
Next actions

FPS-8 and FPS-10 flash prommers must be updated using *Phoenix*.

Updating FPS-8 and FPS-10 flash prommer software

Steps

1. Start *Phoenix* service software, and log in.
2. Choose the correct connection for your flash prommer: **File→Manage Connections...**
3. Choose **Flashing→Prommer maintenance** .
4. To update the **FPS-8/FPS-10** software, click **Update**, and select the appropriate file *fps8upd.ini* (for FPS-8) or *fpsxupd.ini* (for FPS-10) from *C:|Program Files|Nokia|Phoenix|Flash*.



Open

Look in: Flash

03.09.002
3.09.002
fps8upd.ini
fpsxupd.ini

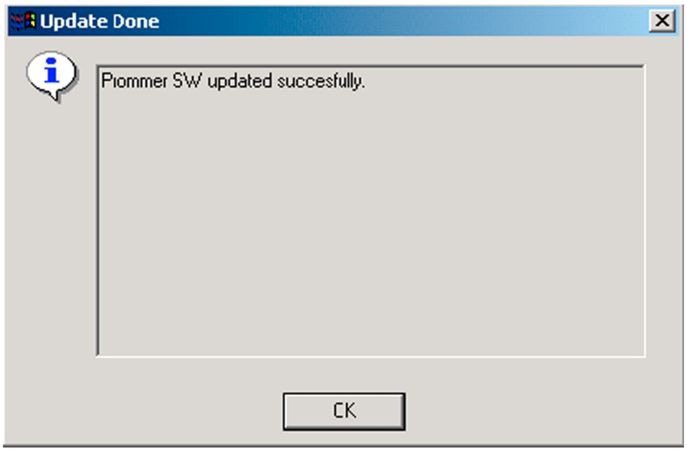
File name: fps8upd.ini

Files of type: Ini files (*.ini)

Figure 24 Flash directory window

Tip: All files can be loaded separately to the prommer used. To do this, click the right mouse button in the *Flash Box Files* pane and select the file type(s) to be loaded.

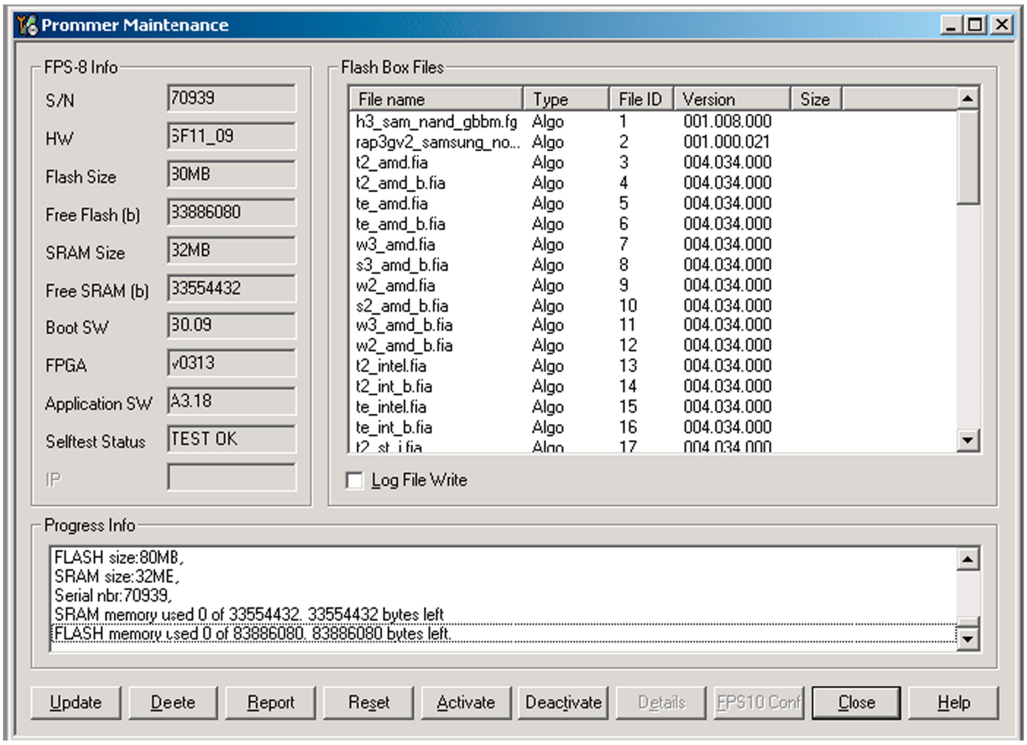
5. Click **OK**.



Prommer SW updated succesfully.

Figure 25 Prommer software update finished

6. To close the *Prommer Maintenance* window, click **Close**.



S/N: 70939
HW: 5F11_09
Flash Size: 30MB
Free Flash (b): 33886080
SRAM Size: 32MB
Free SRAM (b): 33554432
Boot SW: 30.09
FPGA: v0313
Application SW: A3.18
Selftest Status: TEST OK
IP:

File name	Type	File ID	Version	Size
h3_sam_nand_gbbm.fg	Algo	1	001.008.000	
rap3gv2_samsung_no...	Algo	2	001.000.021	
t2_amd.fia	Algo	3	004.034.000	
t2_amd_b.fia	Algo	4	004.034.000	
te_amd.fia	Algo	5	004.034.000	
te_amd_b.fia	Algo	6	004.034.000	
w3_amd.fia	Algo	7	004.034.000	
s3_amd_b.fia	Algo	8	004.034.000	
w2_amd.fia	Algo	9	004.034.000	
s2_amd_b.fia	Algo	10	004.034.000	
w3_amd_b.fia	Algo	11	004.034.000	
w2_amd_b.fia	Algo	12	004.034.000	
t2_intel.fia	Algo	13	004.034.000	
t2_int_b.fia	Algo	14	004.034.000	
te_intel.fia	Algo	15	004.034.000	
te_int_b.fia	Algo	16	004.034.000	
t2_st_i.fia	Algo	17	004.034.000	

☐ Log File Write

```
FLASH size:80MB,
SRAM size:32ME,
Serial nbr:70939,
SRAM memory used 0 of 33554432. 33554432 bytes left
FLASH memory used 0 of 83886080. 83886080 bytes left.
```

Figure 26 ***Prommer Maintenance*** **window**

Activating FPS-8

Context

Before FPS-8 can be successfully used for phone programming, it must first be activated.

First fill in the *FPS-8 activation request* sheet in the FPS-8 sales package, and follow the instructions given.

When activation file is received (for example, *00000.in*), copy it to the *C:|ProgramFiles|Nokia|Phoenix |BoxActivation* directory on your computer (this directory is created when *Phoenix* is installed).

Steps

1. Start *Phoenix* service software.
2. Choose **Flashing→Prommer Maintenance** .
3. In the *Prommer Maintenance* window, click **Activate**.
4. To find the activation file, click **Browse**.
5. To activate the prommer, select the activation file and click **Open**.

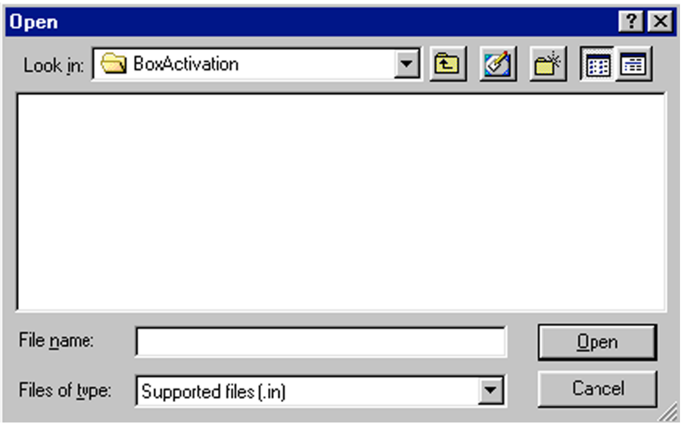

Open
Look in:
BoxActivation
File name:
Files of type:
Supported files (.in)
Open
Cancel

Figure 27 Box activation

6. To complete the activation, restart FPS-8.

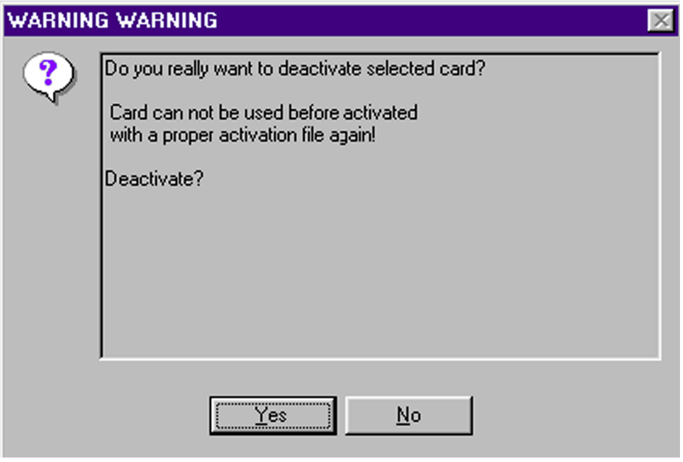
Deactivating FPS-8

Context

If there is, for example, a need to send the FPS-8 box for repair, it must be deactivated first.

Steps

1. Start *Phoenix* service software.
2. Choose **Flashing→Prommer Maintenance** .
3. In the *Prommer Maintenance* window, click **Deactivate**.
4. To confirm the deactivation, click **Yes**.


WARNING WARNING
Yes
No

Do you really want to deactivate selected card?

Card can not be used before activated
with a proper activation file again!

Deactivate?

Figure 28 Deactivation warning

The box is deactivated.

5. To complete the deactivation, restart FPS-8.

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4 — Service Tools and Service Concepts

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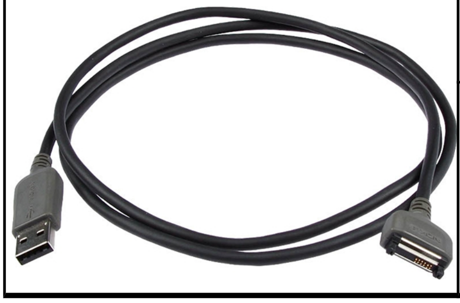
Service tools

The table below gives a short overview of service tools that can be used for testing, error analysis and repair of product RM-170; RM-171, refer to various concepts.

	CA-35S	Power cable	
	CA-35S is a power cable for connecting, for example, the FPS-10 flash prommer to the Point-Of-Sales (POS) flash adapter.		
	CA-53	USB connectivity cable	
	USB to system connector cable.		

CU-4	Control unit	

CU-4 is a general service tool used with a module jig and/or a flash adapter. It requires an external 12 V power supply.

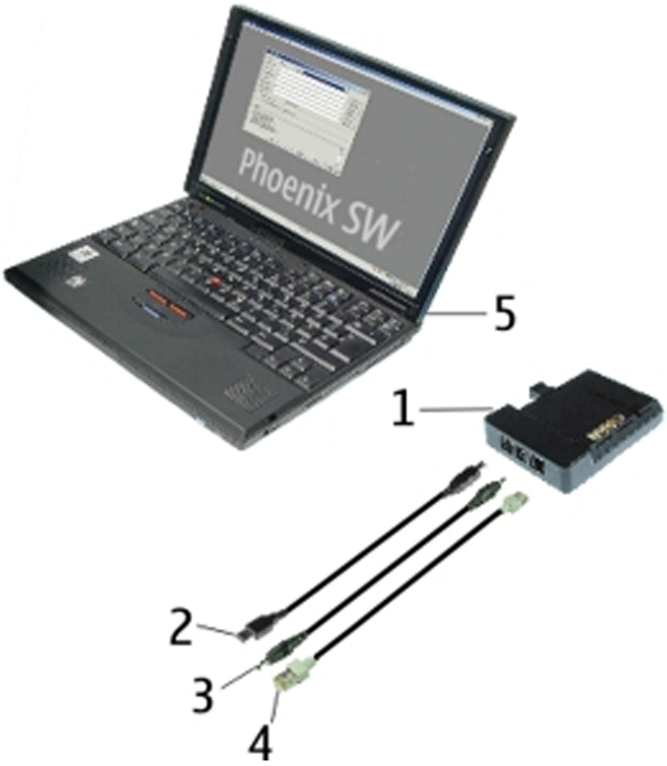
The unit has the following features:

- software controlled via USB
- EM calibration function
- Forwards FBUS/Flashbus traffic to/from terminal
- Forwards USB traffic to/from terminal
- software controlled BSI values
- regulated VBATT voltage
- 2 x USB2.0 connector (Hub)
- FBUS and USB connections supported

When using CU-4, note the special order of connecting cables and other service equipment:

Instructions

1. Connect a service tool (jig, flash adapter) to CU-4.
2. Connect CU-4 to your PC with a USB cable.
3. Connect supply voltage (12 V)
4. Connect an FBUS cable (if necessary).
5. Start Phoenix service software.



Note: Phoenix enables CU-4 regulators via USB when it is started.

Reconnecting the power supply requires a Phoenix restart.

	DKU-2	USB connectivity cable	
	USB to system connector cable.		
NOKIA FLS-4S	FLS-4S	Flash device	
	FLS-4S is a dongle and flash device incorporated into one package, developed specifically for POS use.		

FPS-10	Flash prommer	

FPS-10 interfaces with:

- PC
- Control unit
- Flash adapter
- Smart card

FPS-10 flash prommer features:

- Flash functionality for BB5 and DCT-4 terminals
- Smart Card reader for SX-2 or SX-4
- USB traffic forwarding
- USB to FBUS/Flashbus conversion
- LAN to FBUS/Flashbus and USB conversion
- Vusb output switchable by PC command

FPS-10 sales package includes:

- FPS-10 prommer
- Power Supply with 5 country specific cords
- USB cable

FS-42	Flash adapter	

Flash adapter FS-42 is used for phone testing and flashing. FS-42 is used with the generic flash adapter base and control unit CU-4 or interface adapter.

When flashing or system testing the phone, the adapter is attached to replace the phone own battery. All functions (as well as the calibration voltages, current and the protections for over voltages, over current and voltage polarity), are performed by CU-4.

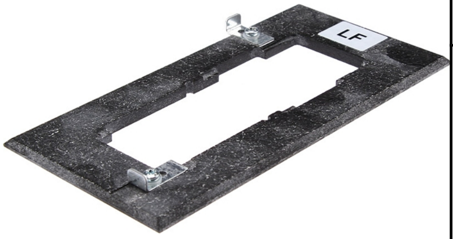
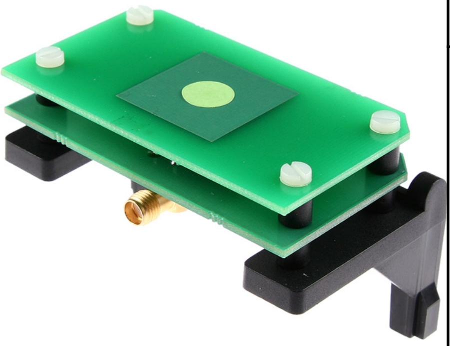
MJ-100	Module jig	

MJ-100 is meant for component level troubleshooting.

The jig includes an RF interface for GSM, WCDMA and Bluetooth. In addition, it has the following features:

- Provides mechanical interface with Engine module
- Provides galvanic connection to all needed test pads in module
- Multiplexing between USB and FBUS media, controlled by Vusb
- UI test interface
- MMC interface
- Duplicated SIM connector
- Audio components: IHF, MIC, earpiece
- Connector for control unit
- Access for the system connector

Note: In the picture CU-4 is connected to MJ-100 . CU-4 is not part of the MJ-100 sales package and has to be ordered separately.

	PCS-1	Power cable	
	The PCS-1 power cable (DC) is used with a docking station, a module jig or a control unit to supply a controlled operating voltage.		
	PKD-1	SW security device	
	SW security device is a piece of hardware enabling the use of the service software when connected to the parallel (LPT) port of the PC. Without the device, it is not possible to use the service software. Printer or any such device can be connected to the PC through the device if needed.		
	RJ-136	Rework jig	
	RJ-136 is a soldering jig used for soldering and as a rework jig for the engine module.		
	SA-119	RF coupler	
	SA-119 is a coupler for GSM RF testing. It is used together with FS-42 flash adapter.		
	SS-46	Interface adapter	
	SS-46 acts as an interface adapter between the flash adapter and FPS-10.		

	SS-62	Flash adapter base	
	Generic base for flash adapters and couplers.		
	XCS-4	Modular cable	
	XCS-4 is a shielded (one specially shielded conductor) modular cable for flashing and service purposes.		
	XRF-1	RF cable	
	The RF cable is used to connect, for example, a module repair jig to the RF measurement equipment. SMA to N-Connector ca. 610mm. Attenuation for: • GSM850/900: 0.3+-0.1 dB • GSM1800/1900: 0.5+-0.1 dB • WLAN: 0.6+-0.1dB		

Service concepts

Flash concept with FPS-10

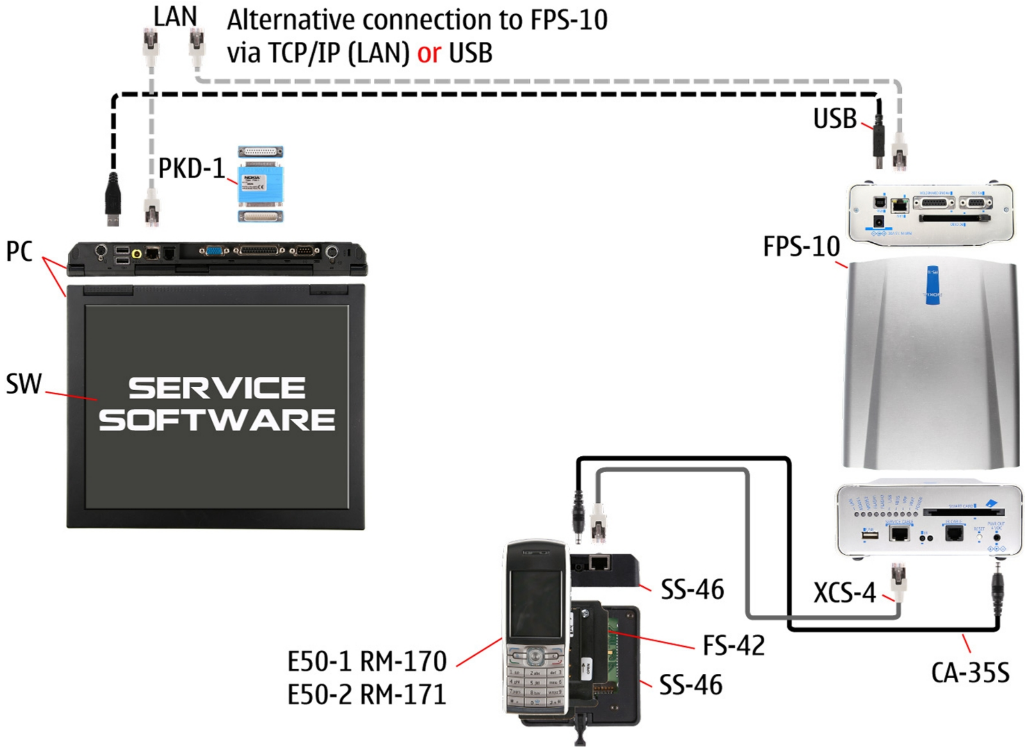

LAN
Alternative connection to FPS-10
via TCP/IP (LAN) or USB
USB
PKD-1
PC
FPS-10
SW
SERVICE
SOFTWARE
SS-46
XCS-4
FS-42
E50-1 RM-170
E50-2 RM-171
SS-46
CA-35S

Figure 29 Basic flash concept with FPS-10

Description	Type
FS-42	Flash adapter
SS-46	Interface adapter
CA-35S	Power cable
XCS-4	Modular cable
FPS-10	Flash prommer box
CA-31D	USB cable
PKD-1	SW security device

Flash concept with FPS-10 (USB)

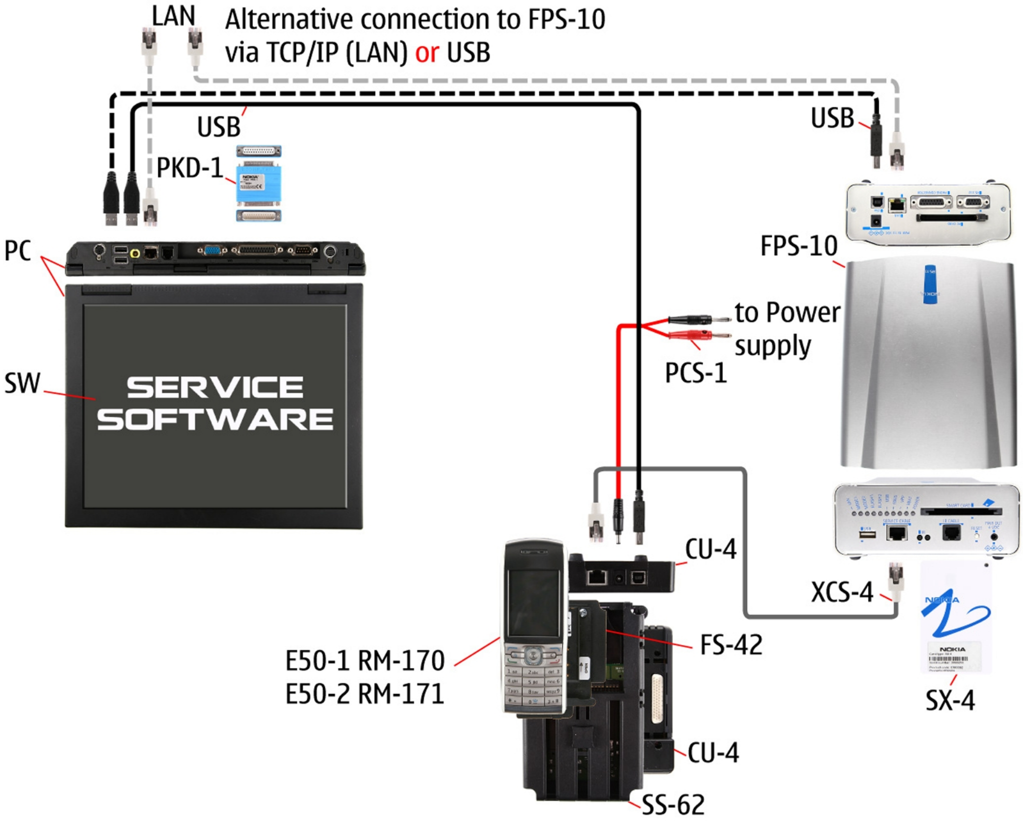

LAN
Alternative connection to FPS-10
via TCP/IP (LAN) or USB
USB
PKD-1
USB
PC
FPS-10
to Power
supply
PCS-1
SW
SERVICE
SOFTWARE
CU-4
XCS-4
FS-42
E50-1 RM-170
E50-2 RM-171
SX-4
CU-4
SS-62

Figure 30 Basic flash concept with FPS-10

Description	Type
FS-42	Flash adapter
SS-62	Flash adapter base
CA-35S	Power cable
CU-4	Control unit
FPS-10	Flash prommer box
CA-31D	Standard USB cable
PKD-1	SW security device

MJ-100 module jig concept

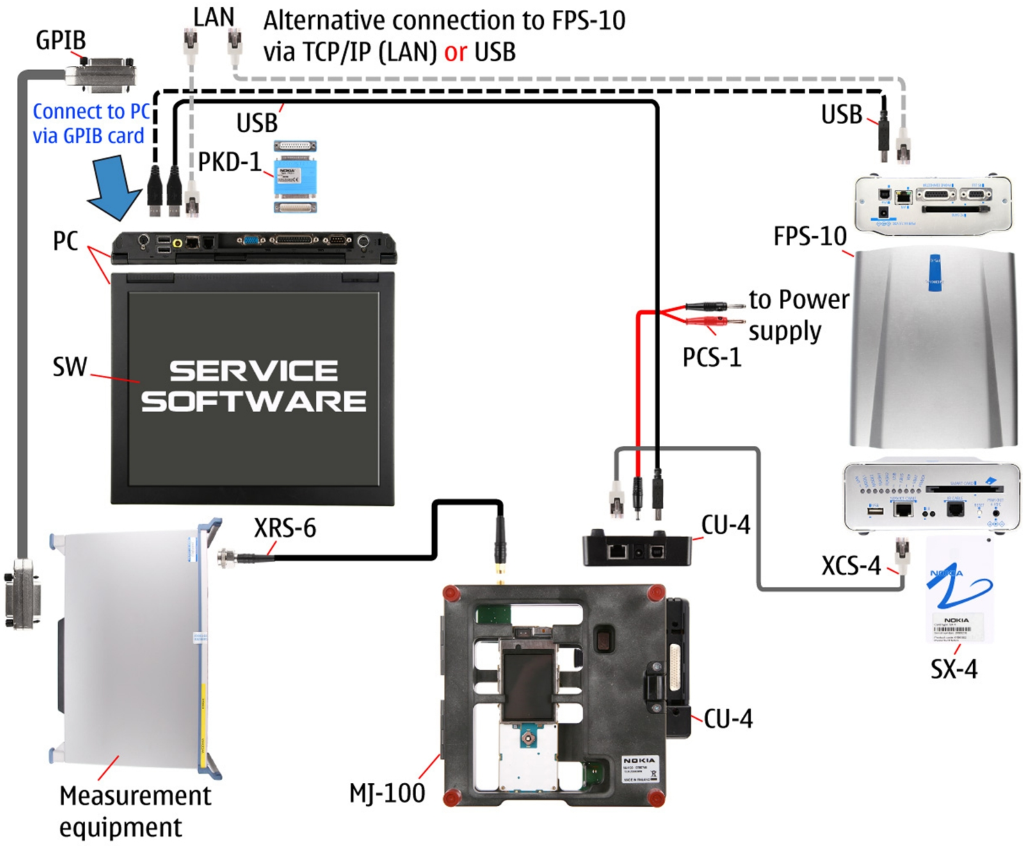

GPIB
LAN
Alternative connection to FPS-10
via TCP/IP (LAN) or USB
Connect to PC
via GPIB card
USB
PKD-1
USB
PC
FPS-10
to Power
supply
PCS-1
SW
SERVICE
SOFTWARE
XRS-6
CU-4
XCS-4
SX-4
CU-4
Measurement
equipment
MJ-100

Figure 31 MJ-100 module jig service concept

Type	Description
MJ-100	Module jig
CU-4	Control unit
FPS-10	Flash prommer
SX-4	Smart card
XCS-4	Modular cable
PCS-1	DC power cable
CA-31D	USB cable
	GPIB control cable
XRS-6	RF cable
PKD-1	SW security device

POS (Point of Sale) flash concept

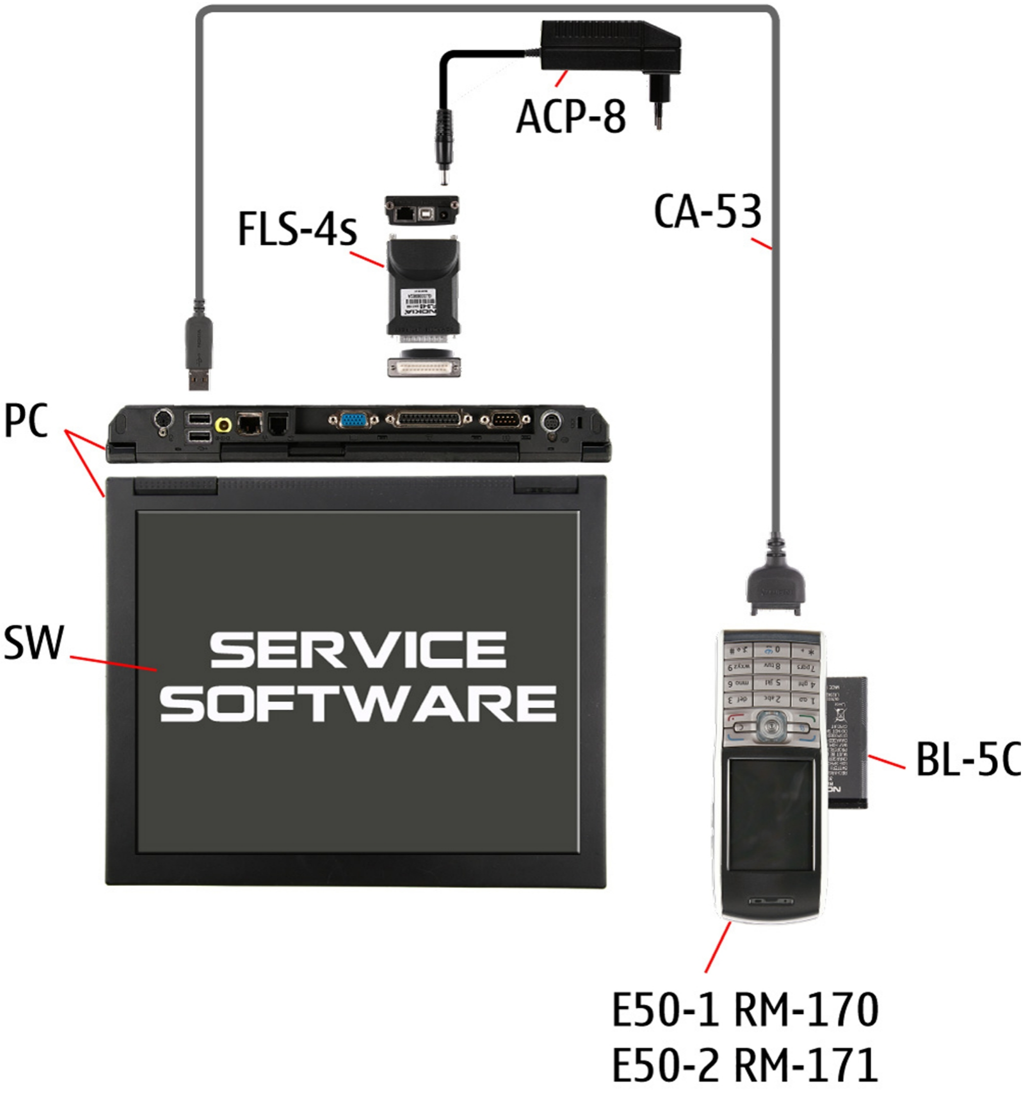

ACP-8
FLS-4s
CA-53
PC
SW
SERVICE SOFTWARE
BL-5C
E50-1 RM-170
E50-2 RM-171

Figure 32 POS flash concept

Type	Description
CA-53	Cable
FLS-4S	POS flash dongle

Service concept for RF testing and RF/BB tuning

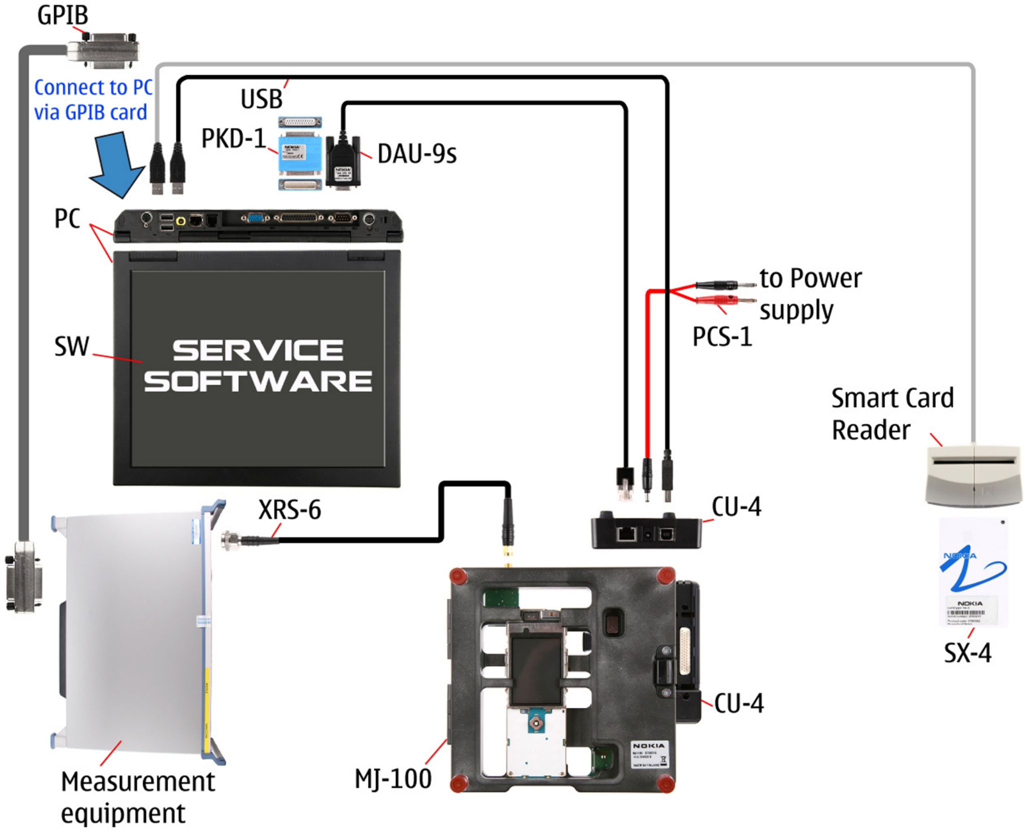

GPIB
Connect to PC via GPIB card
USB
PKD-1
DAU-9s
PC
SW
SERVICE SOFTWARE
to Power supply
PCS-1
Smart Card Reader
XRS-6
CU-4
SX-4
CU-4
Measurement equipment
MJ-100

Figure 33 Service concept for RF testing and RF/BB tuning

Description	Type
MJ-100	Module jig
CU-4	Control unit
CA-31D	USB cable
PCS-1	DC power cable
	Standard USB cable + smart card reader
SX-4	Smart card
XRS-6	RF cable
	GPIB control cable
PKD-1	SW security device

RF testing concept with RF coupler

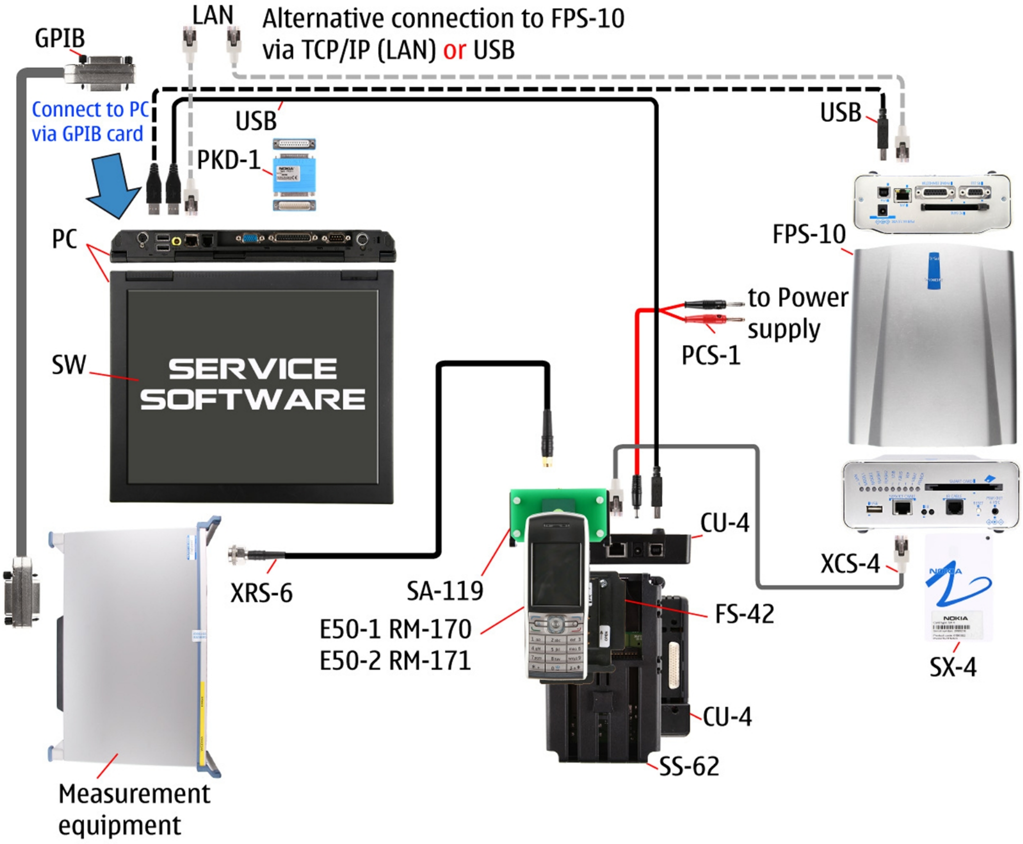

LAN
Alternative connection to FPS-10
via TCP/IP (LAN) or USB
GPIB
Connect to PC
via GPIB card
USB
PKD-1
USB
PC
FPS-10
to Power
supply
PCS-1
SW
SERVICE
SOFTWARE
CU-4
XCS-4
XRS-6
SA-119
E50-1 RM-170
E50-2 RM-171
FS-42
SX-4
CU-4
SS-62
Measurement
equipment

Figure 34 RF testing concept with RF coupler

Type	Description
FS-42	Flash adapter
CU-4	Control unit
SA-119	RF coupler
PCS-1	Power cable
XCS-4	Cable
SS-62	Jig
CA-31D	USB cable
SX-4	Smart card
	GPIB control cable
XRS-6	RF cable
PKD-1	SW security device

5 — Disassembly/reassembly instructions

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Reassembly instructions....................5–14

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(This page left intentionally blank.)

Disassembly instructions

Prerequisites

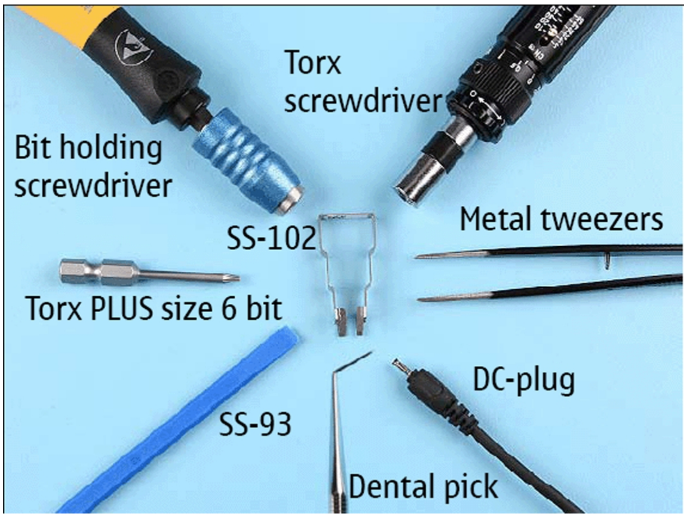
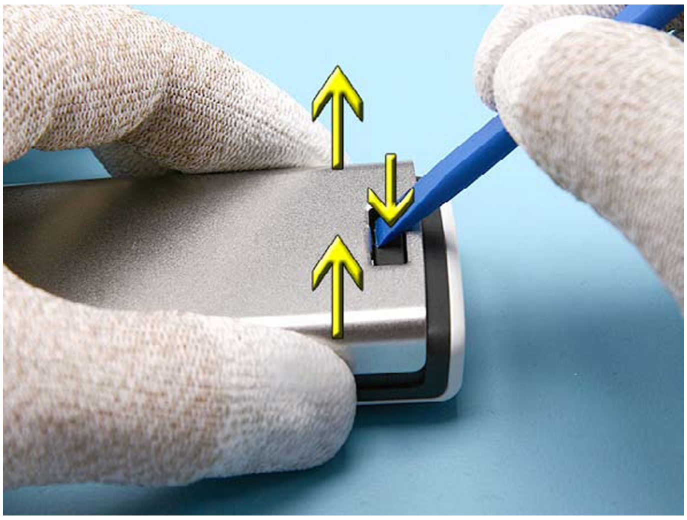

Torx screwdriver
Bit holding screwdriver
Metal tweezers
SS-102
Torx PLUS size 6 bit
DC-plug
SS-93
Dental pick

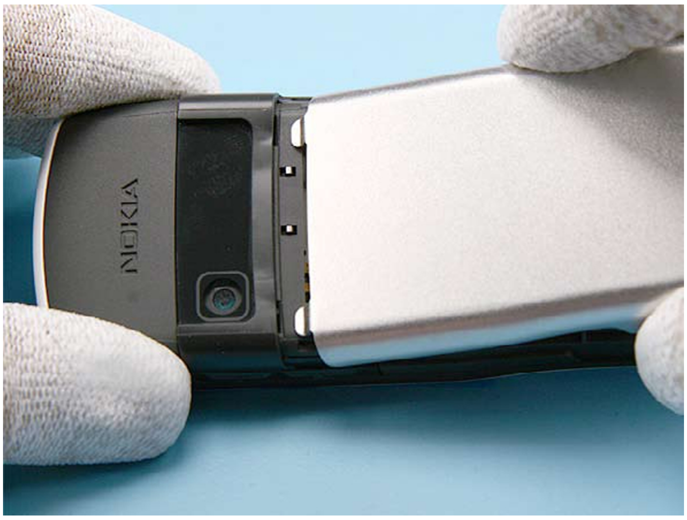
Figure 35 Needed tools: a bit holding screwdriver, a Torque screwdriver, a Torx PLUS size 6 bit, metal tweezers, a DC plug, the SS-93 opening tool, the SS-102 camera removal tool and a dental pick.

Steps

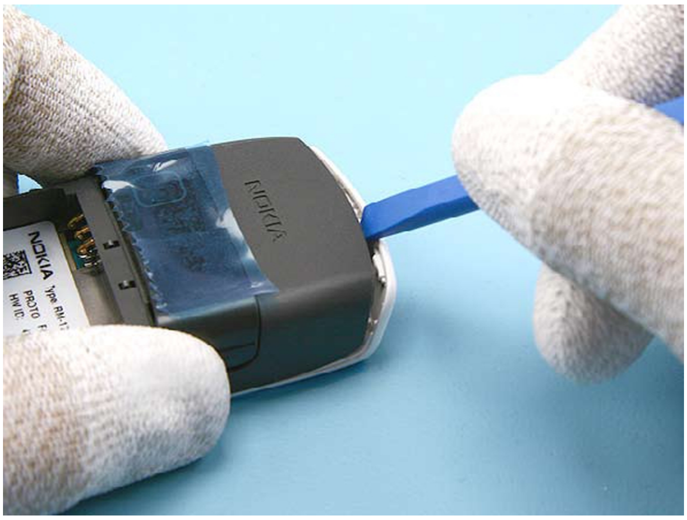
1. Press the BATTERY COVER LATCH and lift a bit the BATTERY COVER ASSEMBLY.



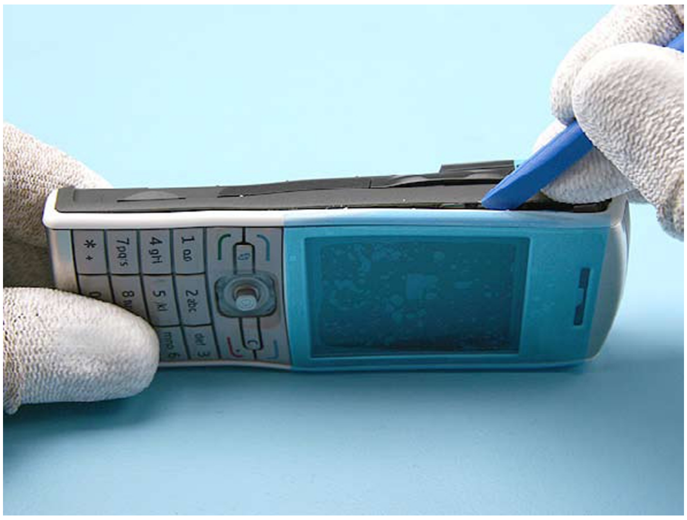
2. Now remove the BATTERY COVER ASSEMBLY.



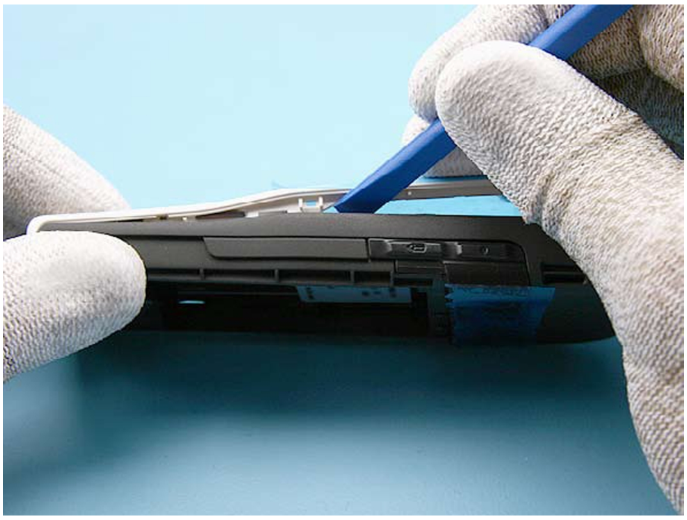
3. Unlock the A-COVER with the SS-93 starting on the top side of the phone.



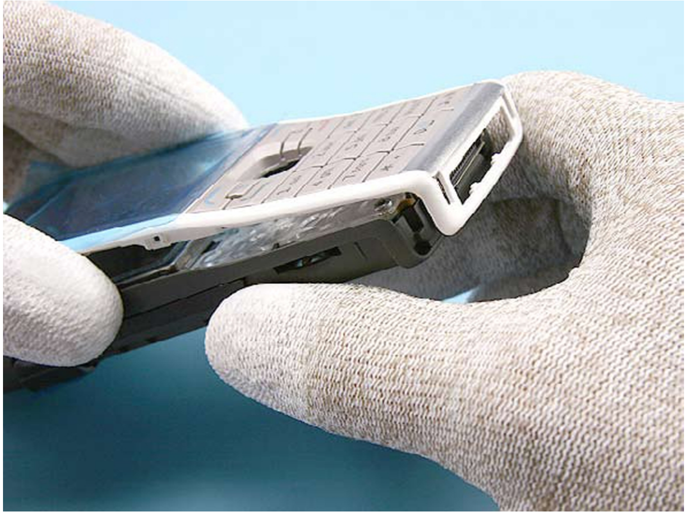
4. Slide the SS-93 along the edge to unlock the snaps.



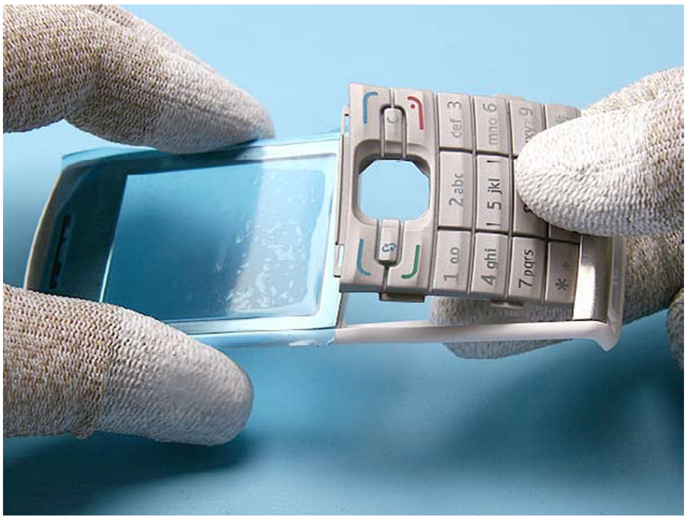
5. Do the same on the other side.



6. Separate the parts from each other.

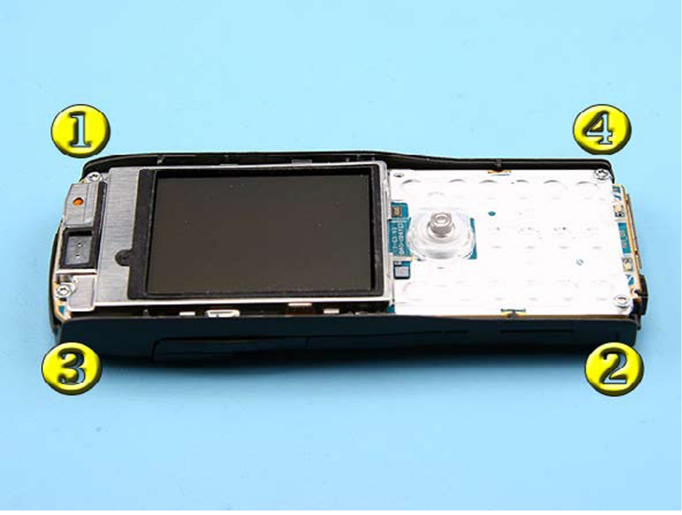


7. Remove the KEYMAT from the A-COVER.

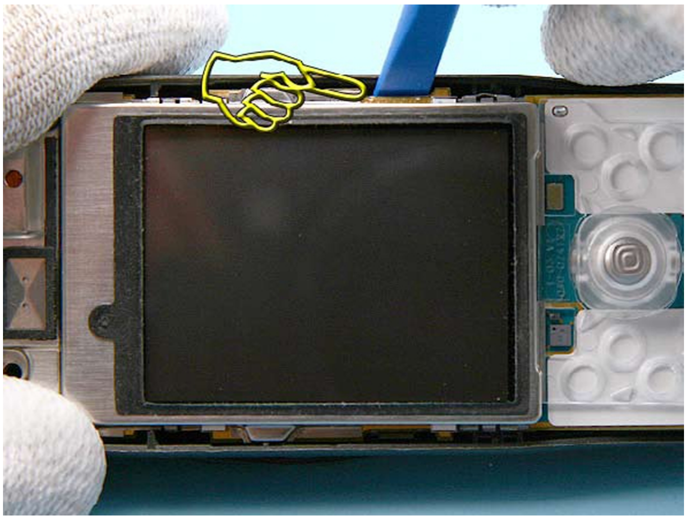


8. Undo the screws in the order shown and remove them.

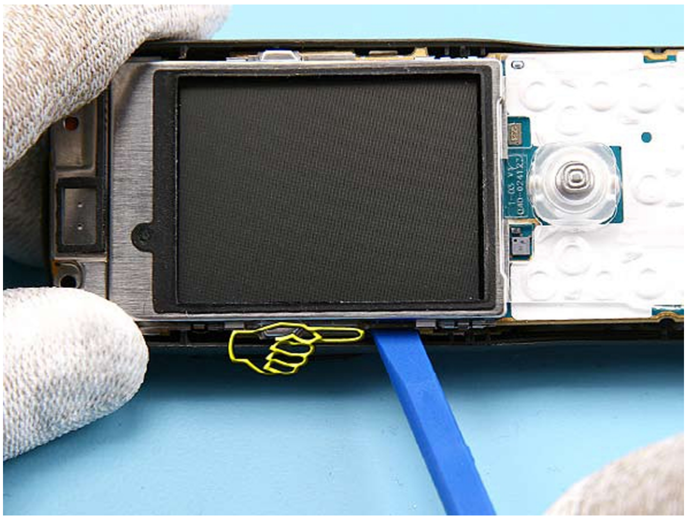
   Note: For assembly: Use the same order and a torque of 20 Ncm for re-assembly.



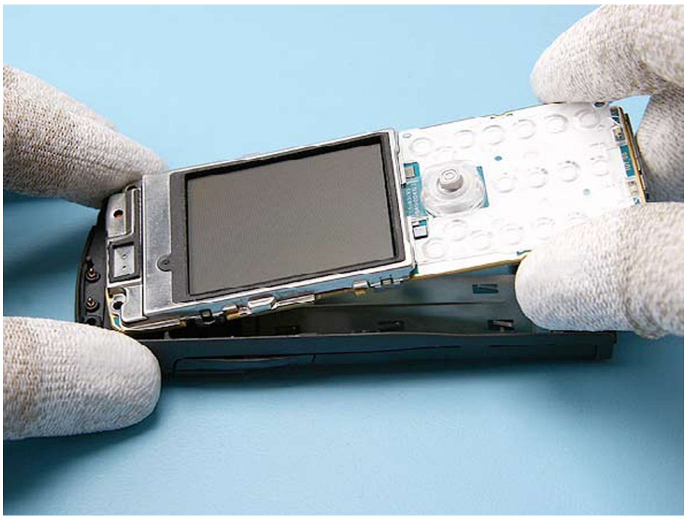
9. Unlock the UI SHIELD ASSEMBLY with the SS-93.



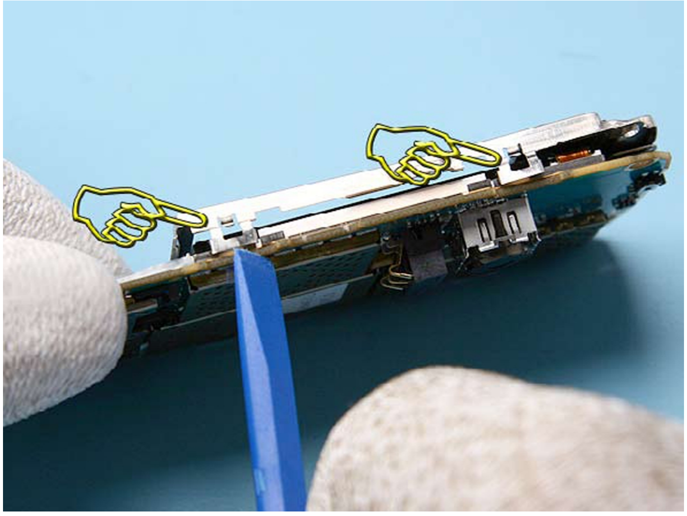
10. Unlock the second snap of the UI SHIELD.



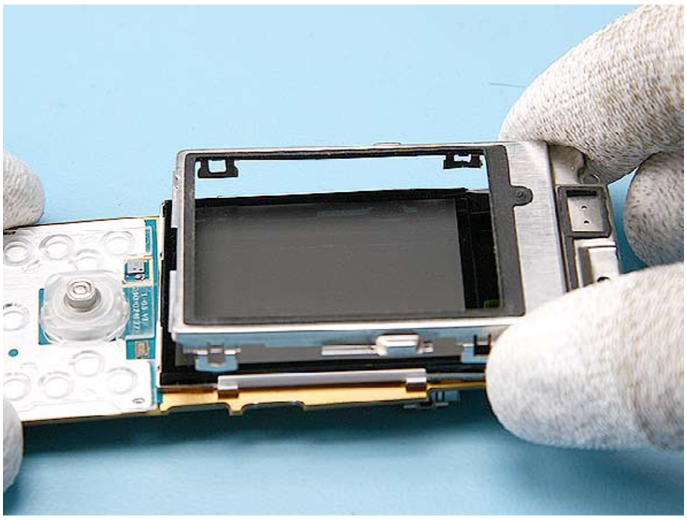
11. Remove the ENGINE MODULE from the B-COVER.



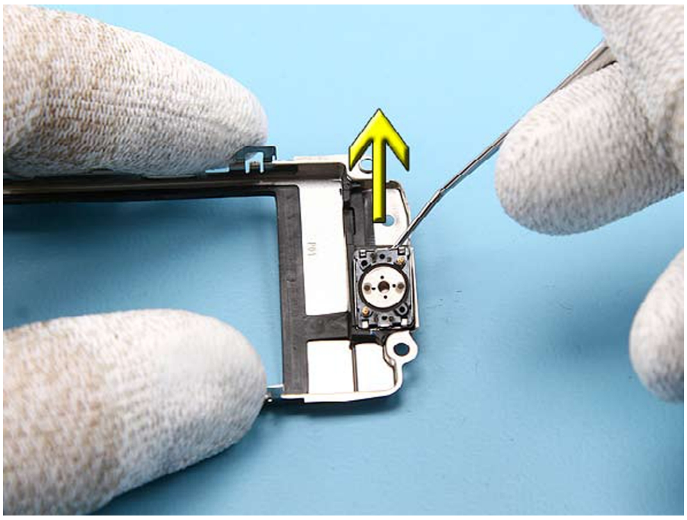
12. Use the SS-93 to open the snaps of the UI SHIELD.



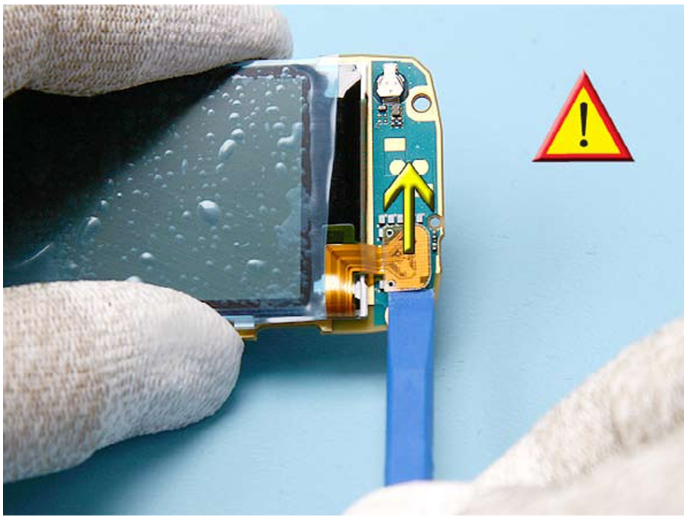
13. Now, remove the UI SHIELD.



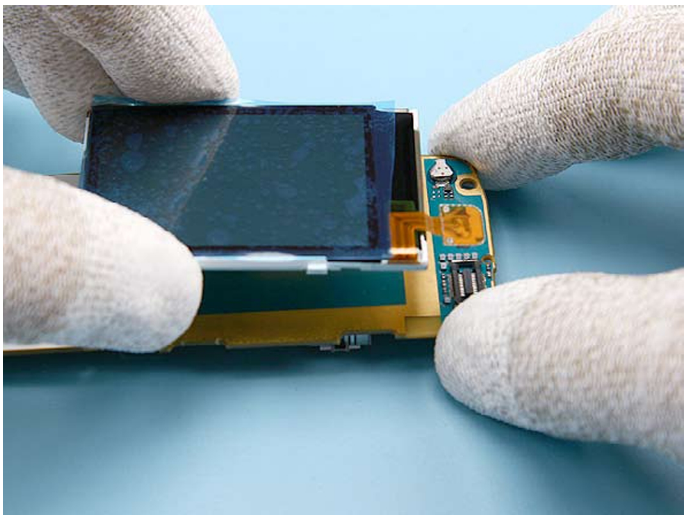
14. Remove the EARPIECE.



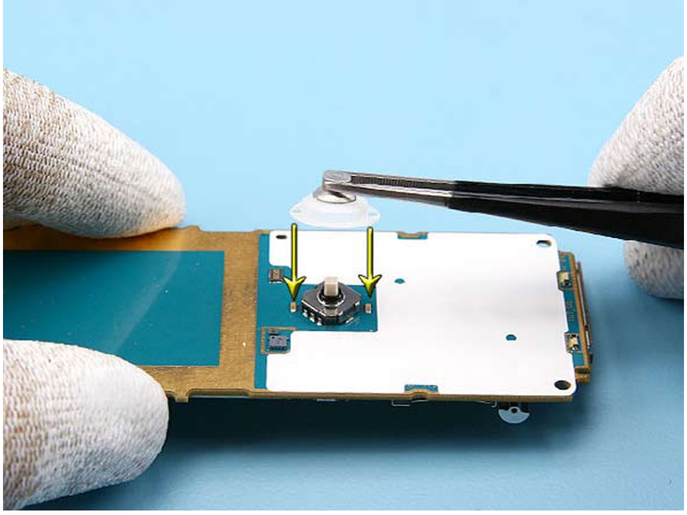
15. Carefully, open the LCD connector with the SS-93 paying attention to the surrounding components.



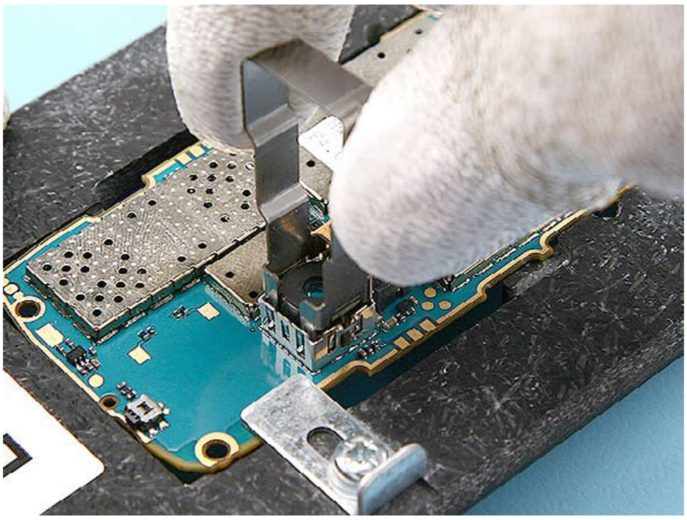
16. Remove the LCD.



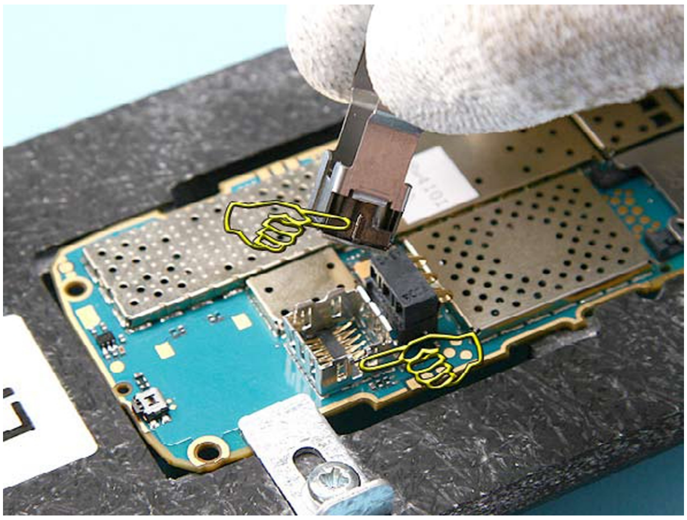
17. Use tweezers to remove the JOYSTICK HAT. Note the right position to JOYSTICK HAT when assembling the unit.



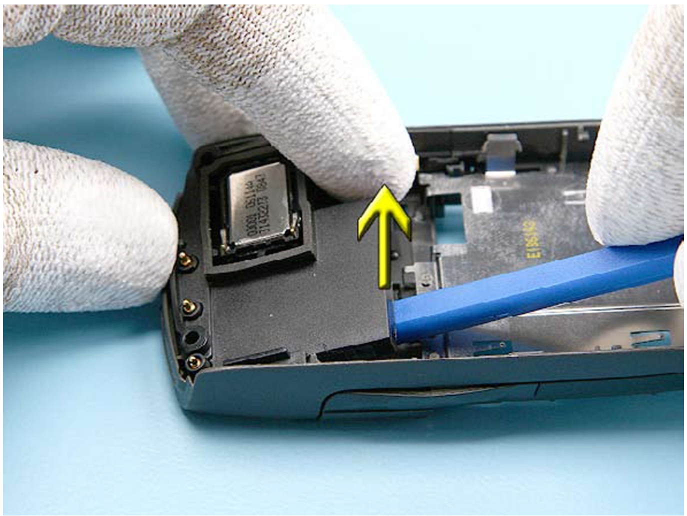
18. Unlock and remove the CAMERA MODULE with the SS-102 camera removal tool.



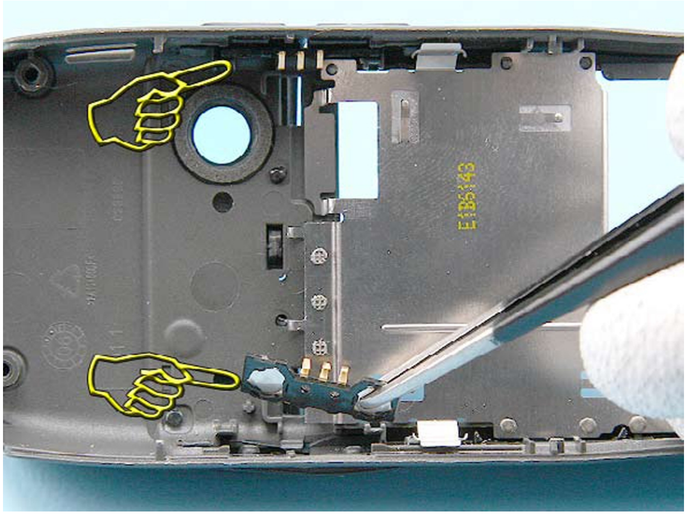
19. Note the right position of the CAMERA MODULE when assembling the unit.



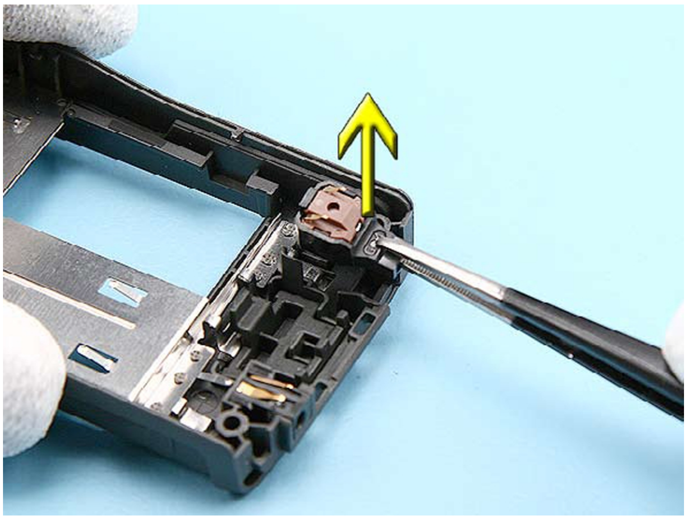
20. Remove the 1GSM ANTENNA MODULE.



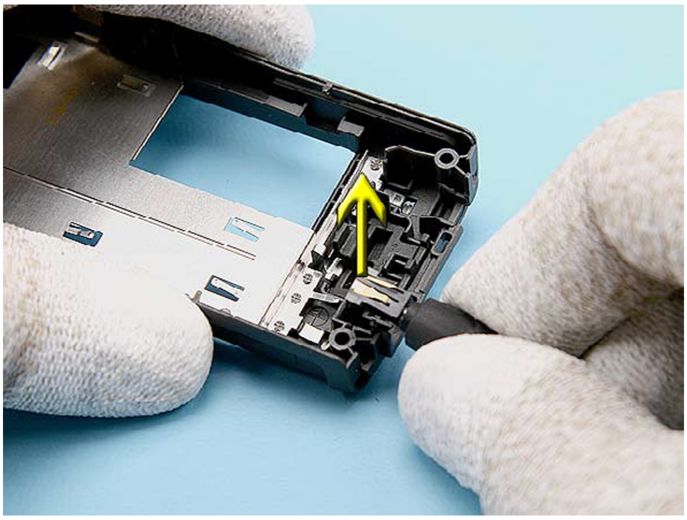
21. Gently, remove the VOLUME and FUNCTION switches using tweezers.



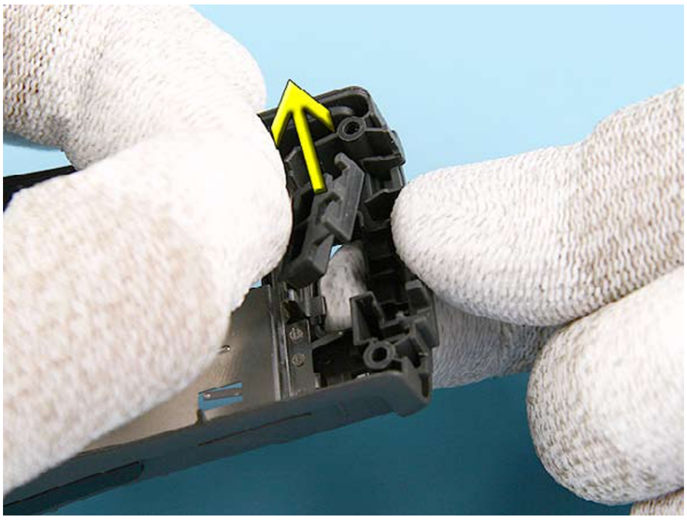
22. Remove the MICROPHONE avoiding bending the spring contacts.



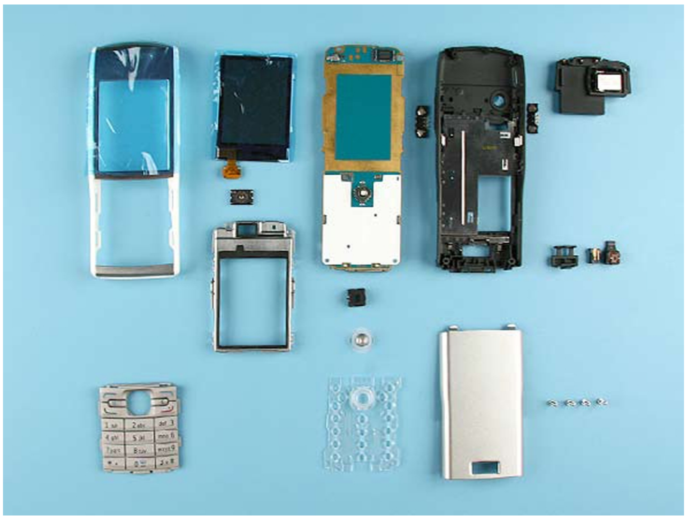
23. Use the DC-plug to unlock and remove the DC-JACK.



24. Remove the BATTERY COVER LATCH.



25. The disassembly procedure is now complete.



Reassembly instructions

For reassembly, follow the disassembly instructions, but in reversed order, unless otherwise stated.

6 — BB Troubleshooting and Manual Tuning Guide

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Figure 46 Single-ended output waveform of the HP_in_Ext_out loop when microphone is connected.... 6–33

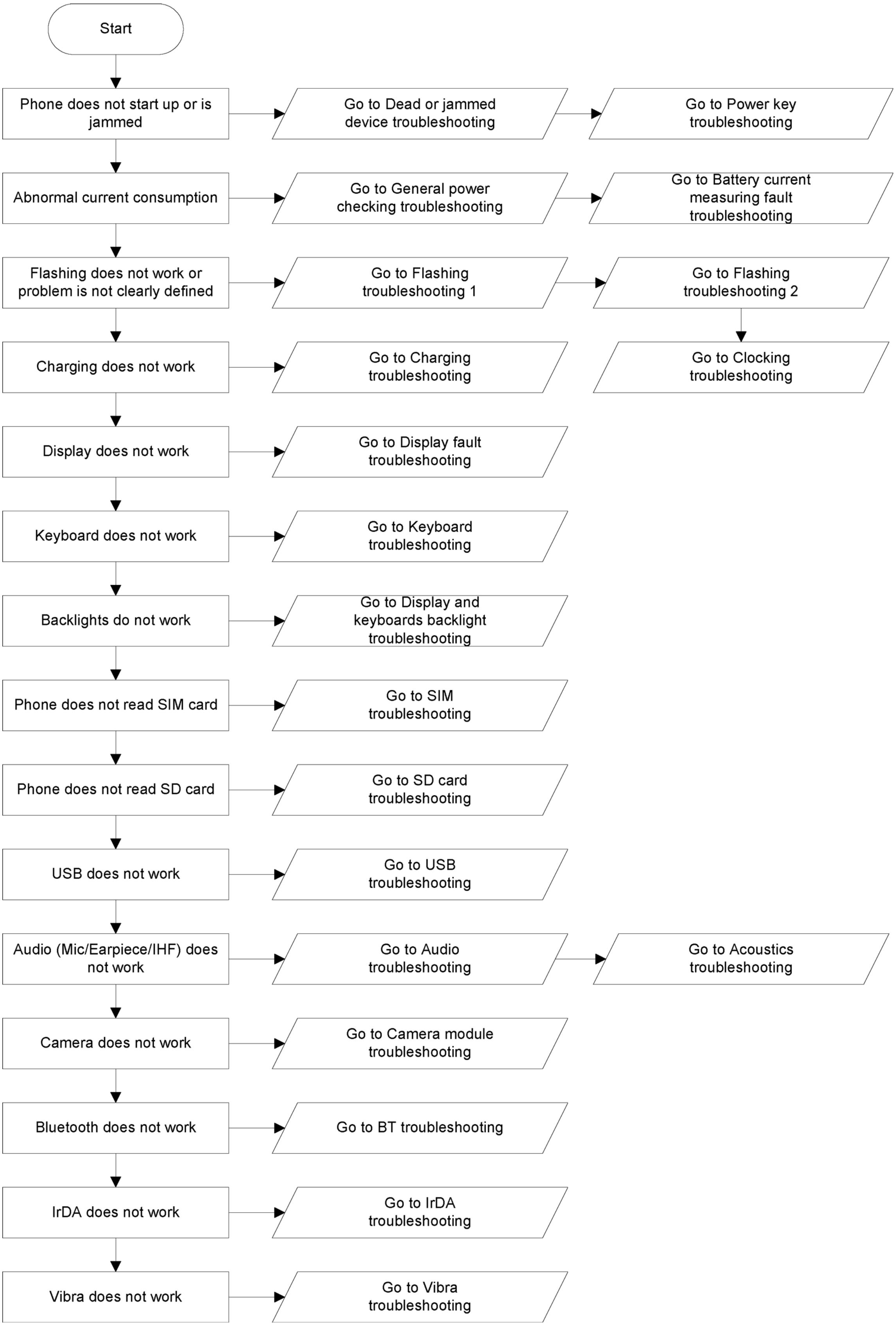
Baseband troubleshooting

Context

This section is intended to be a guide for localising and repairing electrical faults. The fault repairing is divided into troubleshooting paths.

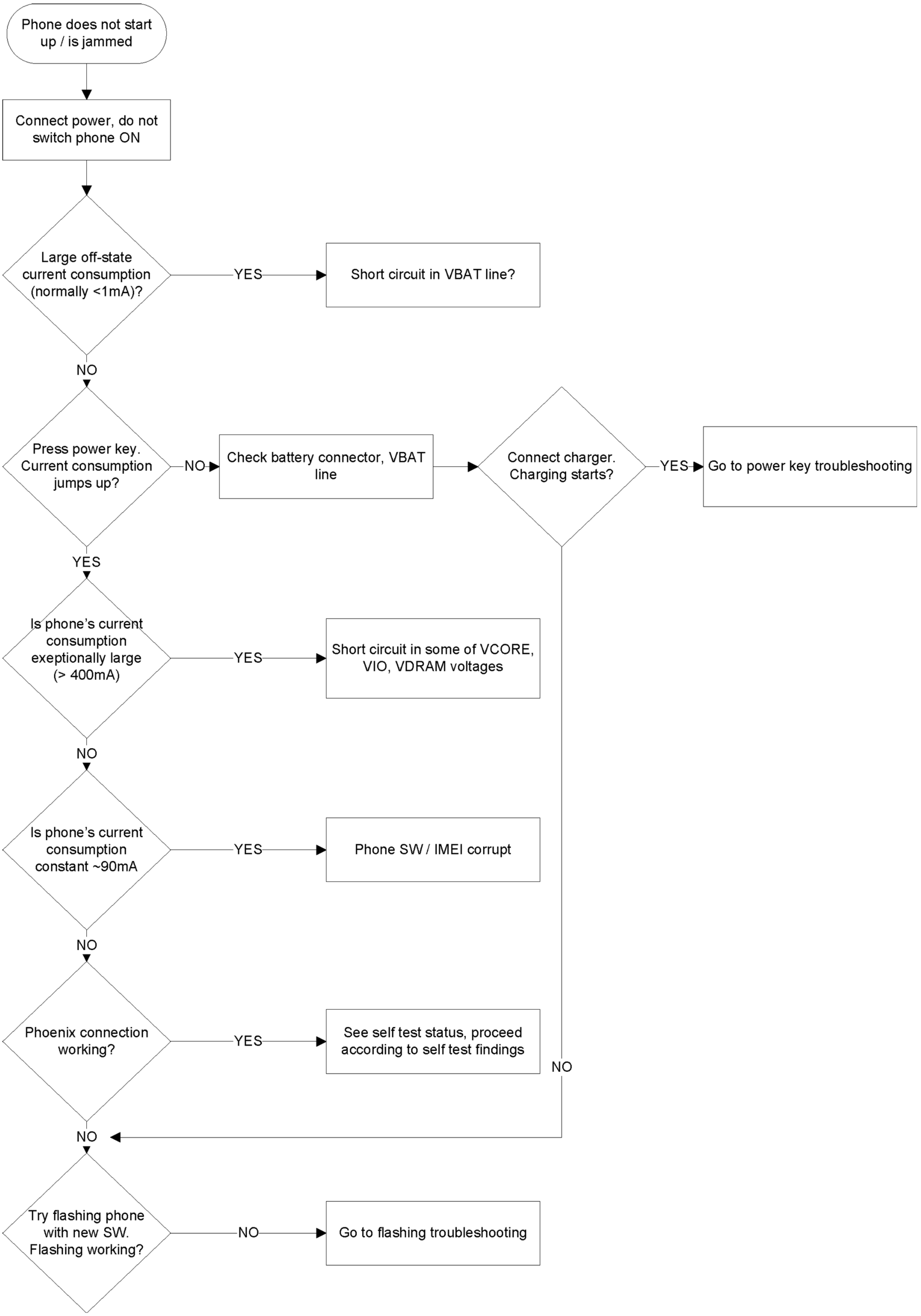
The following main troubleshooting tree describes the different baseband troubleshooting paths to be followed in fault situations.

Troubleshooting flow


Start
Phone does not start up or is jammed
Go to Dead or jammed device troubleshooting
Go to Power key troubleshooting
Abnormal current consumption
Go to General power checking troubleshooting
Go to Battery current measuring fault troubleshooting
Flashing does not work or problem is not clearly defined
Go to Flashing troubleshooting 1
Go to Flashing troubleshooting 2
Charging does not work
Go to Charging troubleshooting
Go to Clocking troubleshooting
Display does not work
Go to Display fault troubleshooting
Keyboard does not work
Go to Keyboard troubleshooting
Backlights do not work
Go to Display and keyboards backlight troubleshooting
Phone does not read SIM card
Go to SIM troubleshooting
Phone does not read SD card
Go to SD card troubleshooting
USB does not work
Go to USB troubleshooting
Audio (Mic/Earpiece/IHF) does not work
Go to Audio troubleshooting
Go to Acoustics troubleshooting
Camera does not work
Go to Camera module troubleshooting
Bluetooth does not work
Go to BT troubleshooting
IrDA does not work
Go to IrDA troubleshooting
Vibra does not work
Go to Vibra troubleshooting

General power checking troubleshooting

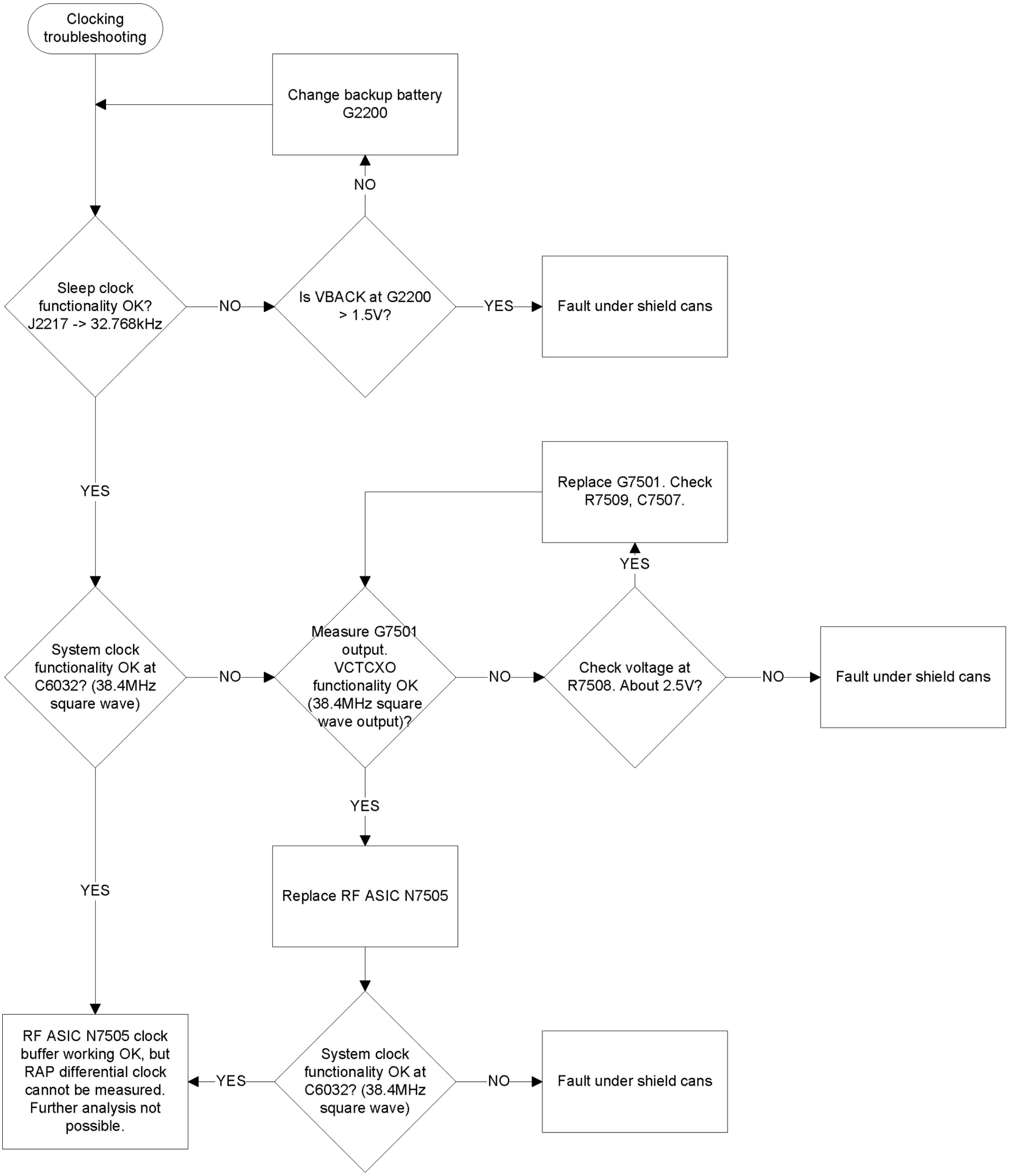
Troubleshooting flow

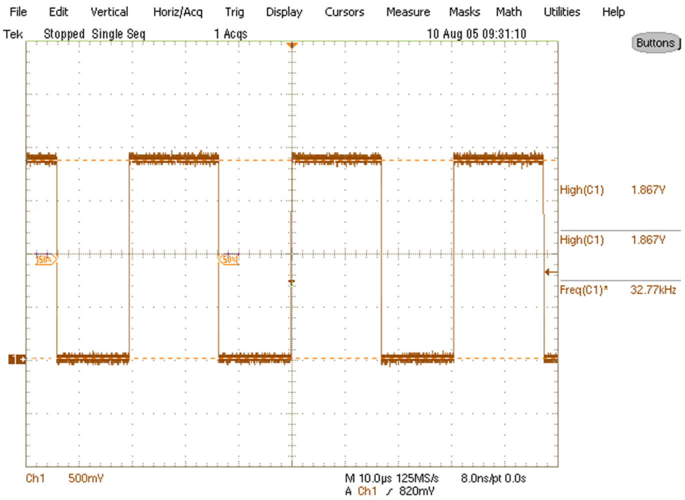

Phone does not start up / is jammed
Connect power, do not switch phone ON
Large off-state current consumption (normally <1mA)?
YES
Short circuit in VBAT line?
NO
Press power key. Current consumption jumps up?
NO
Check battery connector, VBAT line
Connect charger. Charging starts?
YES
Go to power key troubleshooting
YES
Is phone's current consumption exceptionally large (> 400mA)
YES
Short circuit in some of VCORE, VIO, VDRAM voltages
NO
Is phone's current consumption constant ~90mA
YES
Phone SW / IMEI corrupt
NO
Phoenix connection working?
YES
See self test status, proceed according to self test findings
NO
NO
Try flashing phone with new SW. Flashing working?
NO
Go to flashing troubleshooting

]

Clocking troubleshooting

Troubleshooting flow


Clocking troubleshooting
Change backup battery G2200
NO
Sleep clock functionality OK? J2217 -> 32.768kHz
NO
Is VBACK at G2200 > 1.5V?
YES
Fault under shield cans
YES
Replace G7501. Check R7509, C7507.
YES
System clock functionality OK at C6032? (38.4MHz square wave)
NO
Measure G7501 output. VCTCXO functionality OK (38.4MHz square wave output)?
NO
Check voltage at R7508. About 2.5V?
NO
Fault under shield cans
YES
Replace RF ASIC N7505
YES
RF ASIC N7505 clock buffer working OK, but RAP differential clock cannot be measured. Further analysis not possible.
YES
System clock functionality OK at C6032? (38.4MHz square wave)
NO
Fault under shield cans

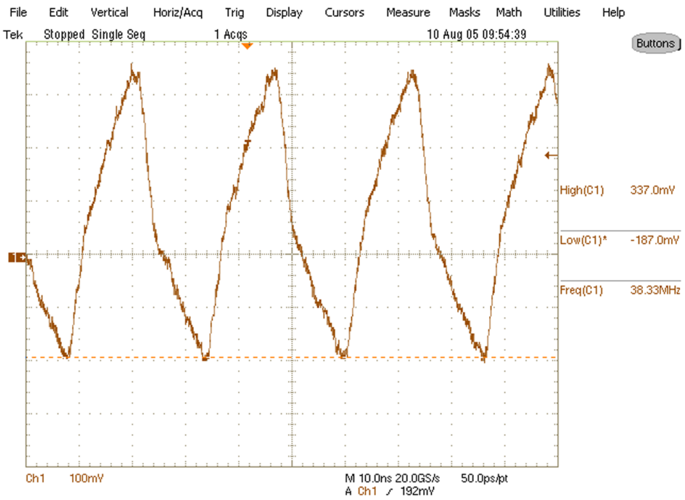

File
Edit
Vertical
Horiz/Acq
Trig
Display
Cursors
Measure
Masks
Math
Utilities
Help
Buttons

Tek Stopped Single Seq 1 Acqs 10 Aug 05 09:31:10

High(C1) 1.867V
High(C1) 1.867V
Freq(C1)* 32.77kHz

Ch1 500mV
M 10.0µs 125MS/s 8.0ns/pt 0.0s
A Ch1 ⁄ 820mV

Figure 36 SleepCLK


File
Edit
Vertical
Horiz/Acq
Trig
Display
Cursors
Measure
Masks
Math
Utilities
Help
Buttons

Tek Stopped Single Seq 1 Acqs 10 Aug 05 09:54:39

High(C1) 337.0mV
Low(C1)* -187.0mV
Freq(C1) 38.33MHz

Ch1 100mV
M 10.0ns 20.0GS/s 50.0ps/pt
A Ch1 ⁄ 192mV

Figure 37 SYSCLK

Display module troubleshooting

General instructions for display troubleshooting

The first step is to verify with a working display that the fault is not on the display module itself. The display module cannot be repaired.

The second step is to check that the cellular engine is working normally. This can be done by connecting the phone to a docking station and starting Phoenix service software. With the help of Phoenix read the phone information to check that also the application engine is functioning normally (you should be able to read the APE ID).

After these checks proceed to the display troubleshooting flowcharts. Use the Display Test tool in Phoenix to find the detailed fault mode.

Operating modes of the display

The display is in a normal mode when the phone is in active use.

The display is in a partial idle mode when the phone is in the screen saver mode.

The operating modes of the display can be controlled with the help of Phoenix.

Table 7 Display module troubleshooting cases

Display blank	There is no image on the display. The display looks the same when the phone is on as it does when the phone is off. The backlight can be on in some cases.
Image on the display not correct	Image on the display can be corrupted or a part of the image can be missing. If a part of the image is missing, change the display module. If the image is otherwise corrupted, follow the appropriate troubleshooting diagram.
Backlight dim or not working at all	Backlight LED components are inside the display module. Backlight failure can also be in the connector or in the backlight power source in the main engine of the phone. Backlight is also controlled automatically by the ambient light sensor. This means that in case the display is working (image OK), but the backlight is not, follow the Display and Keyboard Backlight troubleshooting.
Visual defects (pixel)	Pixel defects can be checked by controlling the display with Phoenix. Use both colours, black and white, on a full screen. The display may have some random pixel defects that are acceptable for this type of display. The criteria when pixel defects are regarded as a display failure, resulting in a replacement of the display, are presented the following table.

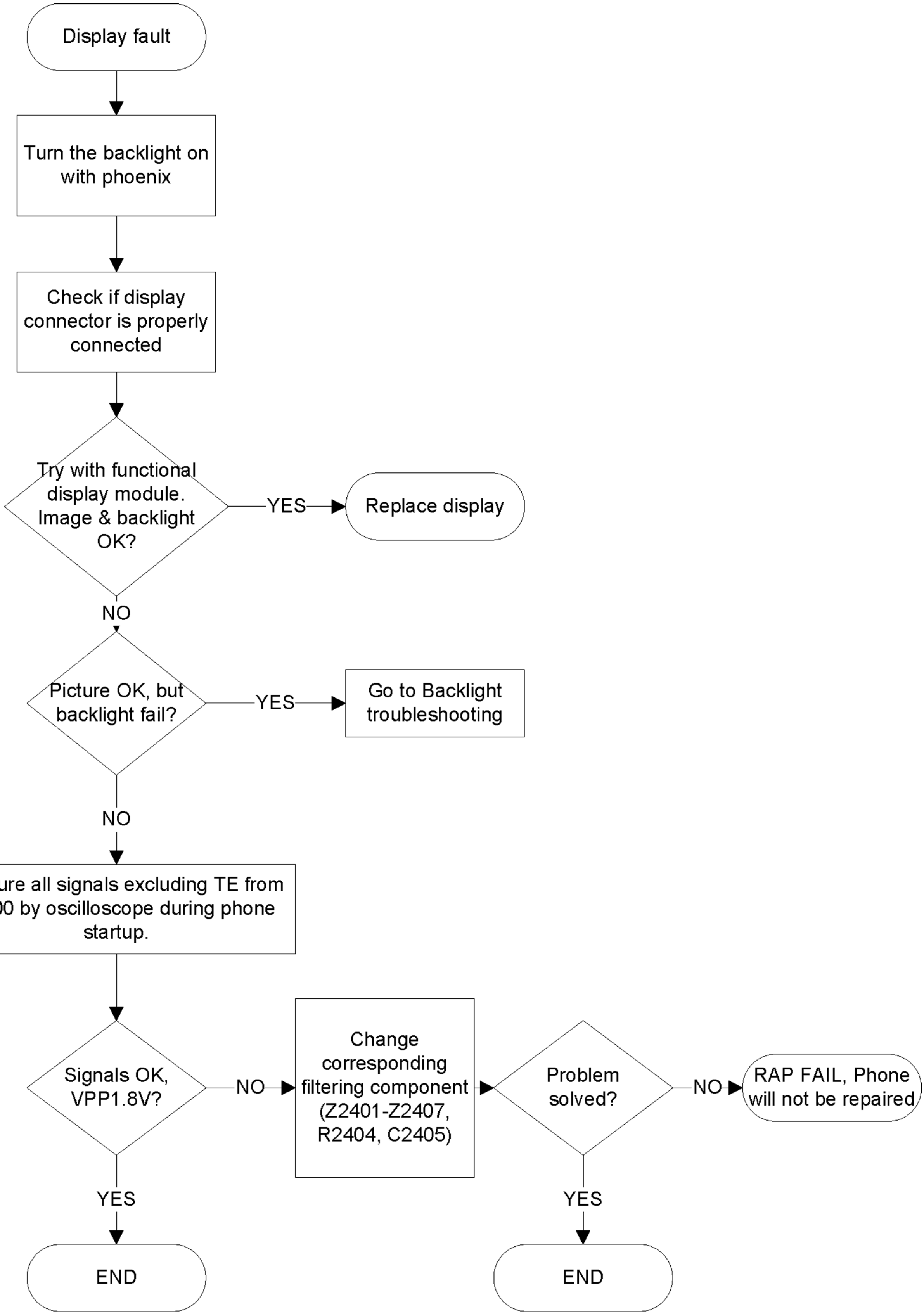
Table 8 Pixel defects

Item		White dot defect				Black dot defect	Total
1	Defect counts	R	G	B	White Dot Total	1	1
		1	1	1	1		
2	Combined defect counts	Not allowed. Two single dot defects that are within 5 mm of each other should be interpreted as combined dot defect.					

Note: Blinking pixels are not allowed in normal operating temperatures and light conditions.

Display fault troubleshooting

Troubleshooting flow

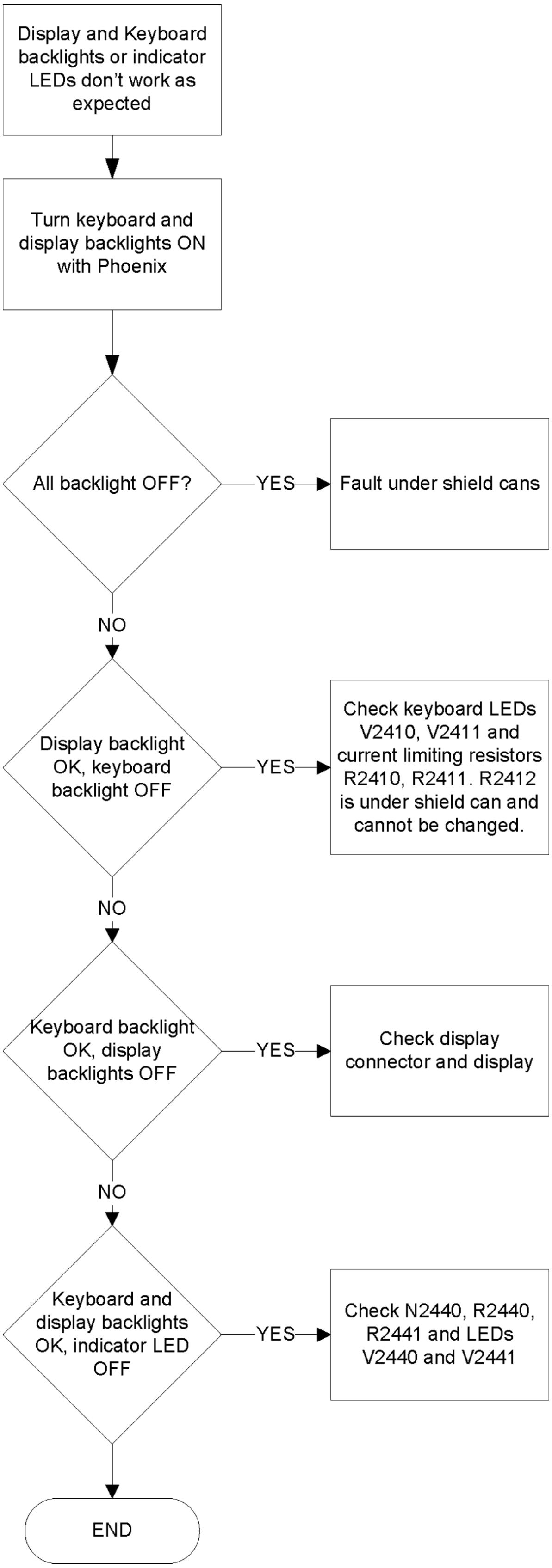

Display fault
Turn the backlight on with phoenix
Check if display connector is properly connected
Try with functional display module. Image & backlight OK?
YES
Replace display
NO
Picture OK, but backlight fail?
YES
Go to Backlight troubleshooting
NO
Measure all signals excluding TE from X2400 by oscilloscope during phone startup.
Signals OK, VPP1.8V?
NO
Change corresponding filtering component (Z2401-Z2407, R2404, C2405)
Problem solved?
NO
RAP FAIL, Phone will not be repaired
YES
END
YES
END

Display and keyboard backlight troubleshooting

Context

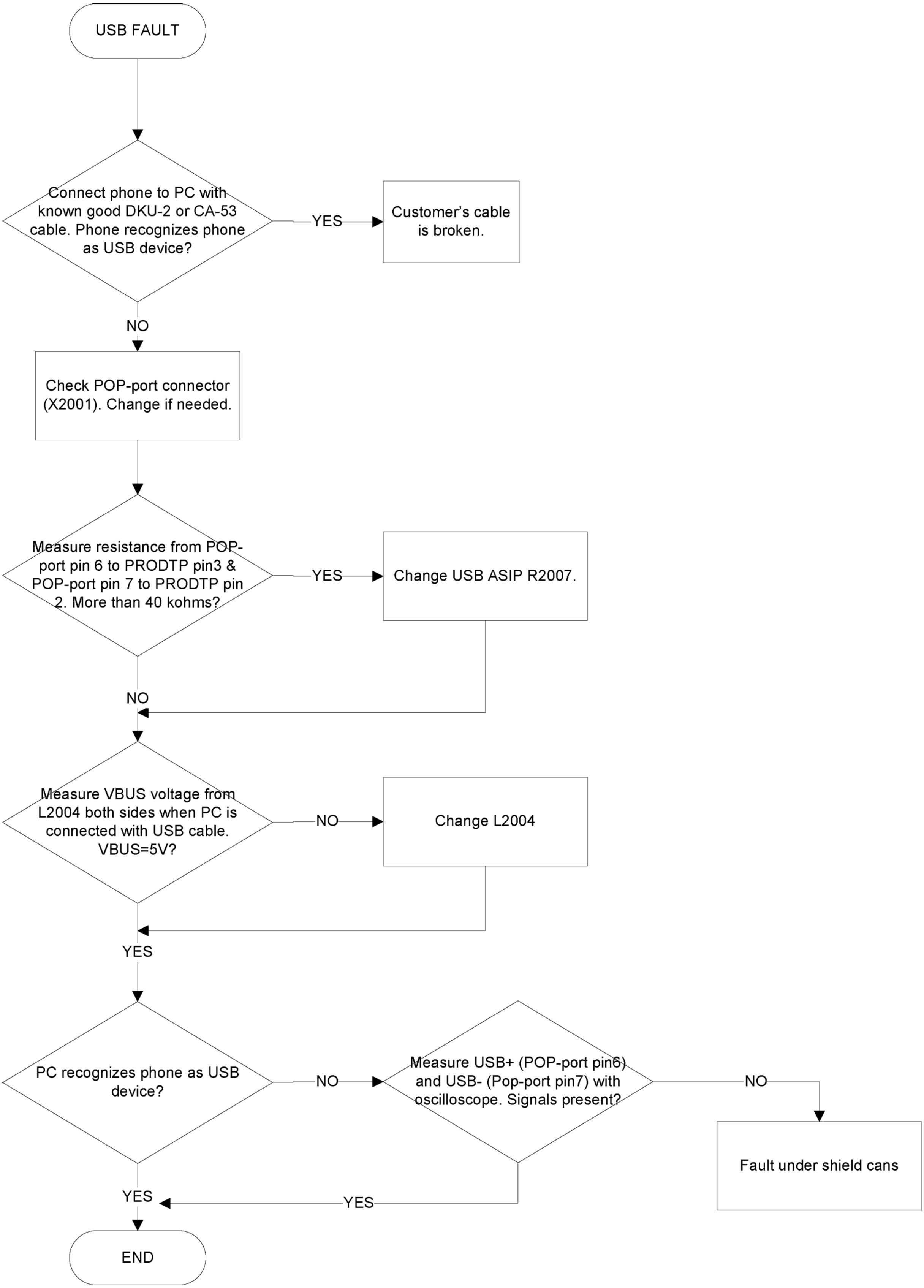
The device has one LED driver that provides current for both display and keyboard backlights. Backlight brightness can be adjusted manually by Phoenix.

Troubleshooting flow


Display and Keyboard backlights or indicator LEDs don't work as expected
Turn keyboard and display backlights ON with Phoenix
All backlight OFF?
YES
Fault under shield cans
NO
Display backlight OK, keyboard backlight OFF
YES
Check keyboard LEDs V2410, V2411 and current limiting resistors R2410, R2411. R2412 is under shield can and cannot be changed.
NO
Keyboard backlight OK, display backlights OFF
YES
Check display connector and display
NO
Keyboard and display backlights OK, indicator LED OFF
YES
Check N2440, R2440, R2441 and LEDs V2440 and V2441
END

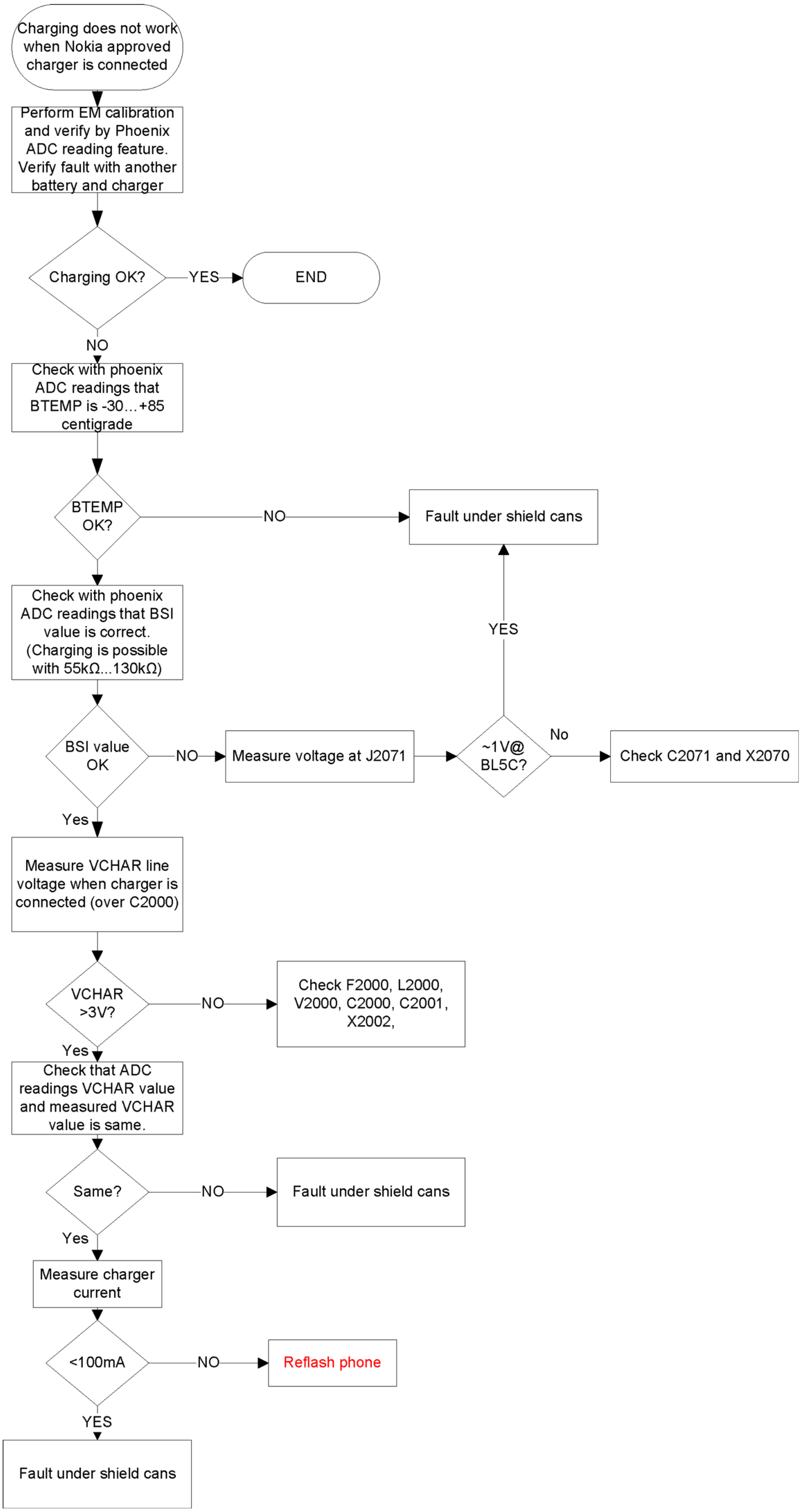
USB troubleshooting

Troubleshooting flow


USB FAULT
Connect phone to PC with known good DKU-2 or CA-53 cable. Phone recognizes phone as USB device?
YES
Customer's cable is broken.
NO
Check POP-port connector (X2001). Change if needed.
Measure resistance from POP-port pin 6 to PRODTP pin3 & POP-port pin 7 to PRODTP pin 2. More than 40 kohms?
YES
Change USB ASIP R2007.
NO
Measure VBUS voltage from L2004 both sides when PC is connected with USB cable. VBUS=5V?
NO
Change L2004
YES
PC recognizes phone as USB device?
NO
Measure USB+ (POP-port pin6) and USB- (Pop-port pin7) with oscilloscope. Signals present?
NO
Fault under shield cans
YES
YES
END

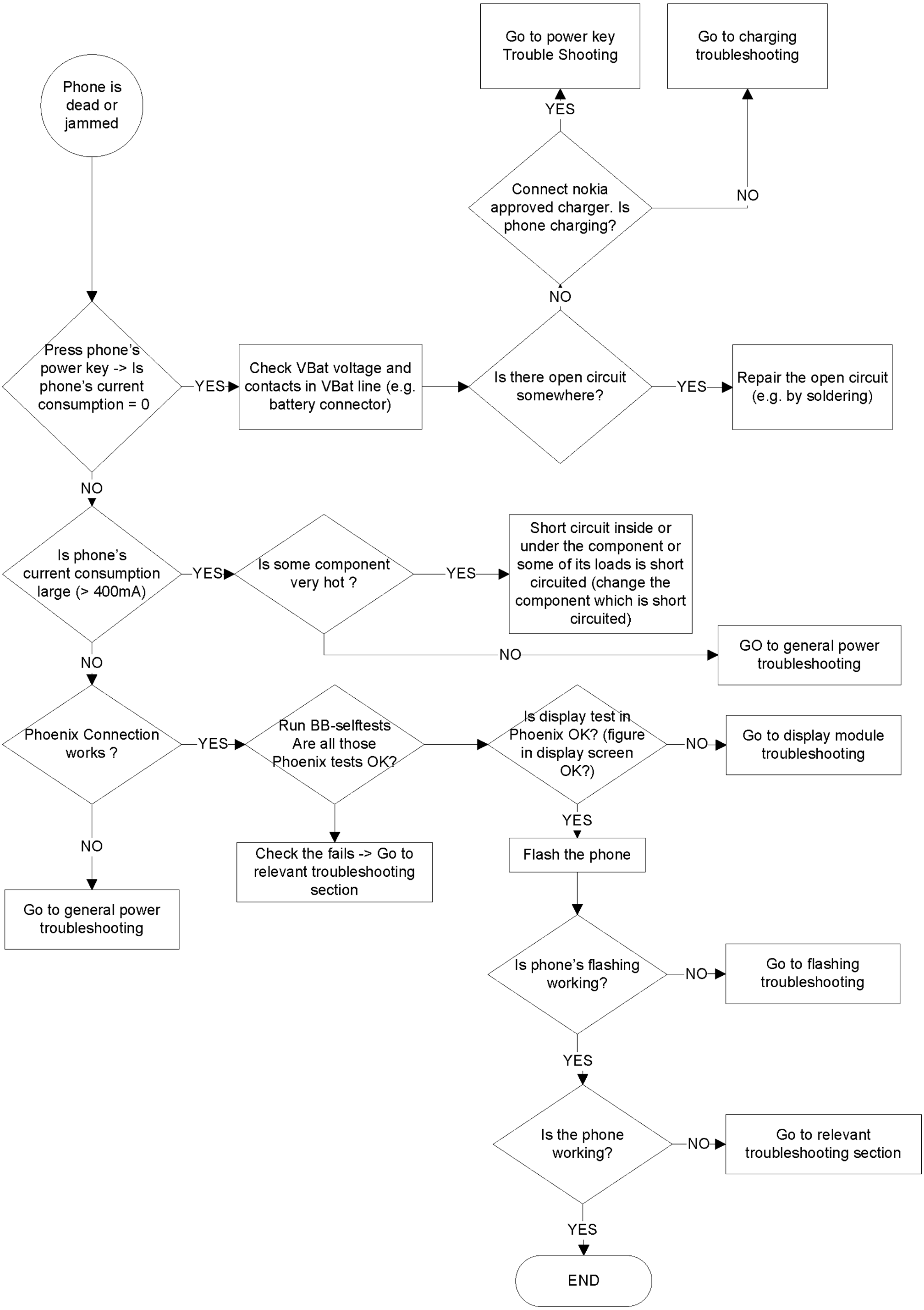
Charging troubleshooting

Troubleshooting flow


Charging does not work when Nokia approved charger is connected
Perform EM calibration and verify by Phoenix ADC reading feature. Verify fault with another battery and charger
Charging OK?
YES
END
NO
Check with phoenix ADC readings that BTEMP is -30…+85 centigrade
BTEMP OK?
NO
Fault under shield cans
Check with phoenix ADC readings that BSI value is correct. (Charging is possible with 55kΩ...130kΩ)
YES
BSI value OK
NO
Measure voltage at J2071
~1V@ BL5C?
No
Check C2071 and X2070
Yes
Measure VCHAR line voltage when charger is connected (over C2000)
VCHAR >3V?
NO
Check F2000, L2000, V2000, C2000, C2001, X2002,
Yes
Check that ADC readings VCHAR value and measured VCHAR value is same.
Same?
NO
Fault under shield cans
Yes
Measure charger current
<100mA
NO
Reflash phone
YES
Fault under shield cans

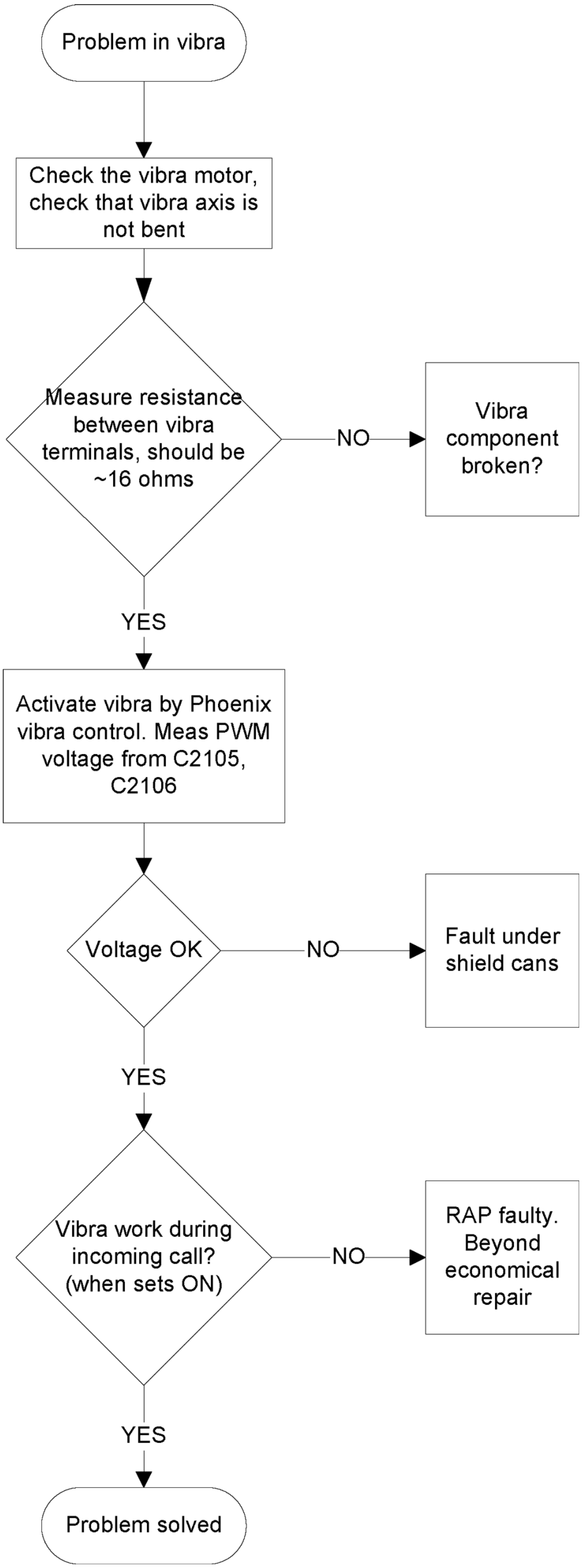
Dead or jammed phone troubleshooting

Troubleshooting flow


Phone is dead or jammed
Press phone's power key -> Is phone's current consumption = 0
YES
Check VBat voltage and contacts in VBat line (e.g. battery connector)
Is there open circuit somewhere?
YES
Repair the open circuit (e.g. by soldering)
NO
Connect nokia approved charger. Is phone charging?
YES
Go to power key Trouble Shooting
NO
Go to charging troubleshooting
NO
Is phone's current consumption large (> 400mA)
YES
Is some component very hot ?
YES
Short circuit inside or under the component or some of its loads is short circuited (change the component which is short circuited)
NO
GO to general power troubleshooting
NO
Phoenix Connection works ?
NO
Go to general power troubleshooting
YES
Run BB-selftests Are all those Phoenix tests OK?
Check the fails -> Go to relevant troubleshooting section
Is display test in Phoenix OK? (figure in display screen OK?)
NO
Go to display module troubleshooting
YES
Flash the phone
Is phone's flashing working?
NO
Go to flashing troubleshooting
YES
Is the phone working?
NO
Go to relevant troubleshooting section
YES
END

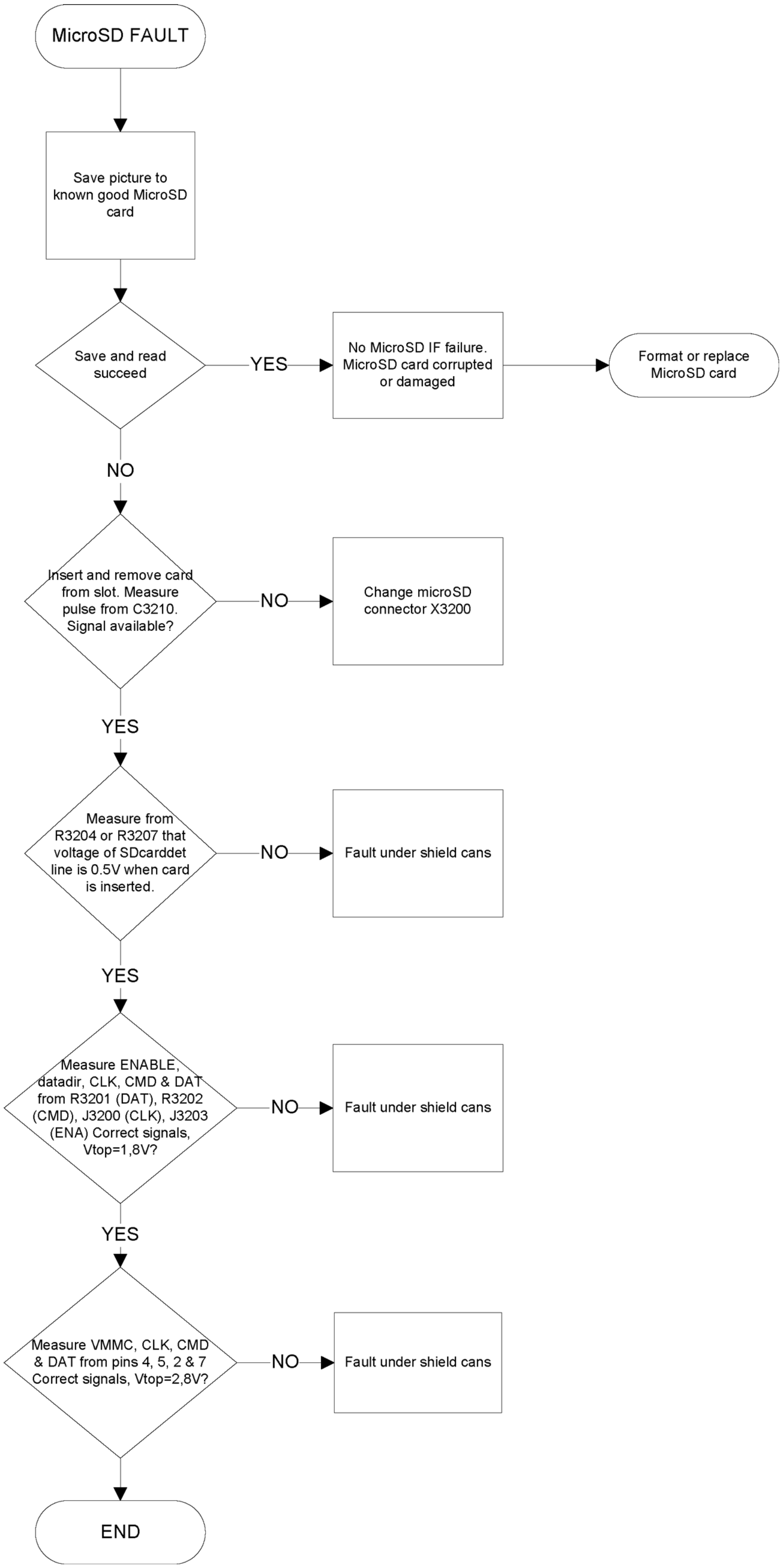
Vibra troubleshooting

Troubleshooting flow


Problem in vibra
Check the vibra motor, check that vibra axis is not bent
Measure resistance between vibra terminals, should be ~16 ohms
NO
Vibra component broken?
YES
Activate vibra by Phoenix vibra control. Meas PWM voltage from C2105, C2106
Voltage OK
NO
Fault under shield cans
YES
Vibra work during incoming call? (when sets ON)
NO
RAP faulty. Beyond economical repair
YES
Problem solved

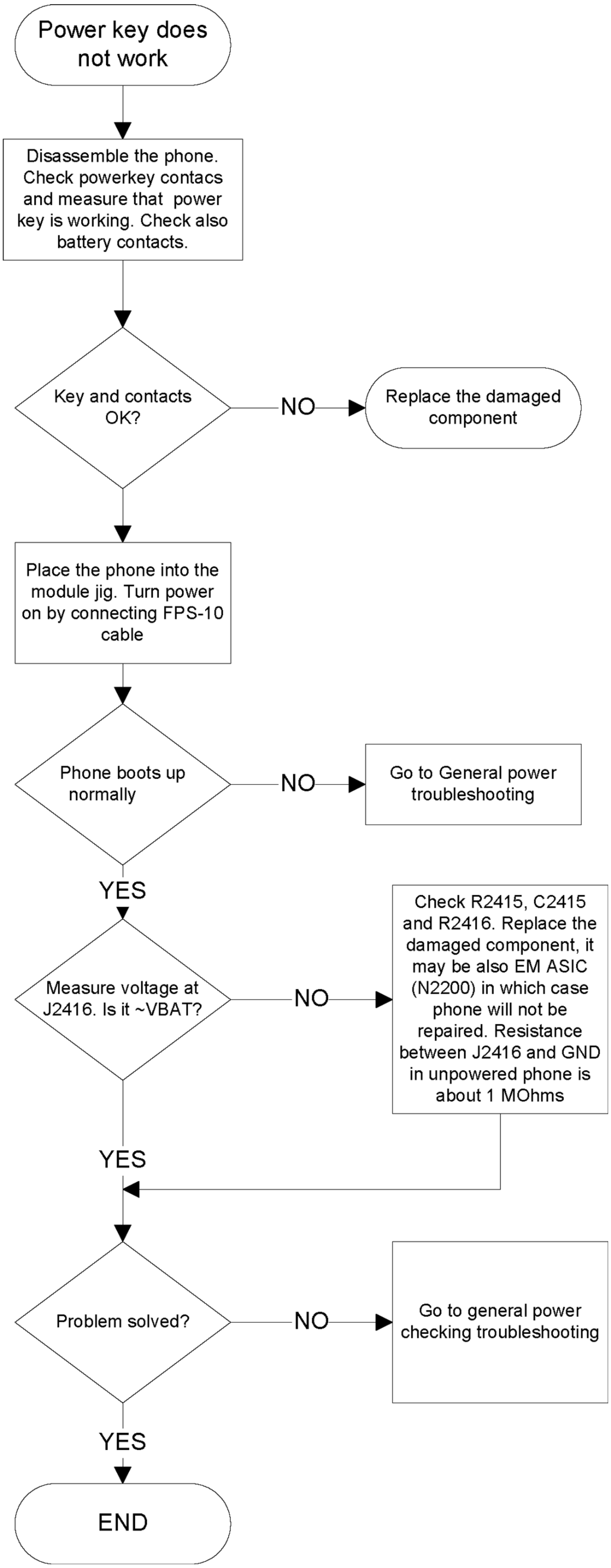
MicroSD troubleshooting

Troubleshooting flow


MicroSD FAULT
Save picture to known good MicroSD card
Save and read succeed
YES
No MicroSD IF failure. MicroSD card corrupted or damaged
Format or replace MicroSD card
NO
Insert and remove card from slot. Measure pulse from C3210. Signal available?
NO
Change microSD connector X3200
YES
Measure from R3204 or R3207 that voltage of SDcarddet line is 0.5V when card is inserted.
NO
Fault under shield cans
YES
Measure ENABLE, datadir, CLK, CMD & DAT from R3201 (DAT), R3202 (CMD), J3200 (CLK), J3203 (ENA) Correct signals, Vtop=1,8V?
NO
Fault under shield cans
YES
Measure VMMC, CLK, CMD & DAT from pins 4, 5, 2 & 7 Correct signals, Vtop=2,8V?
NO
Fault under shield cans
END

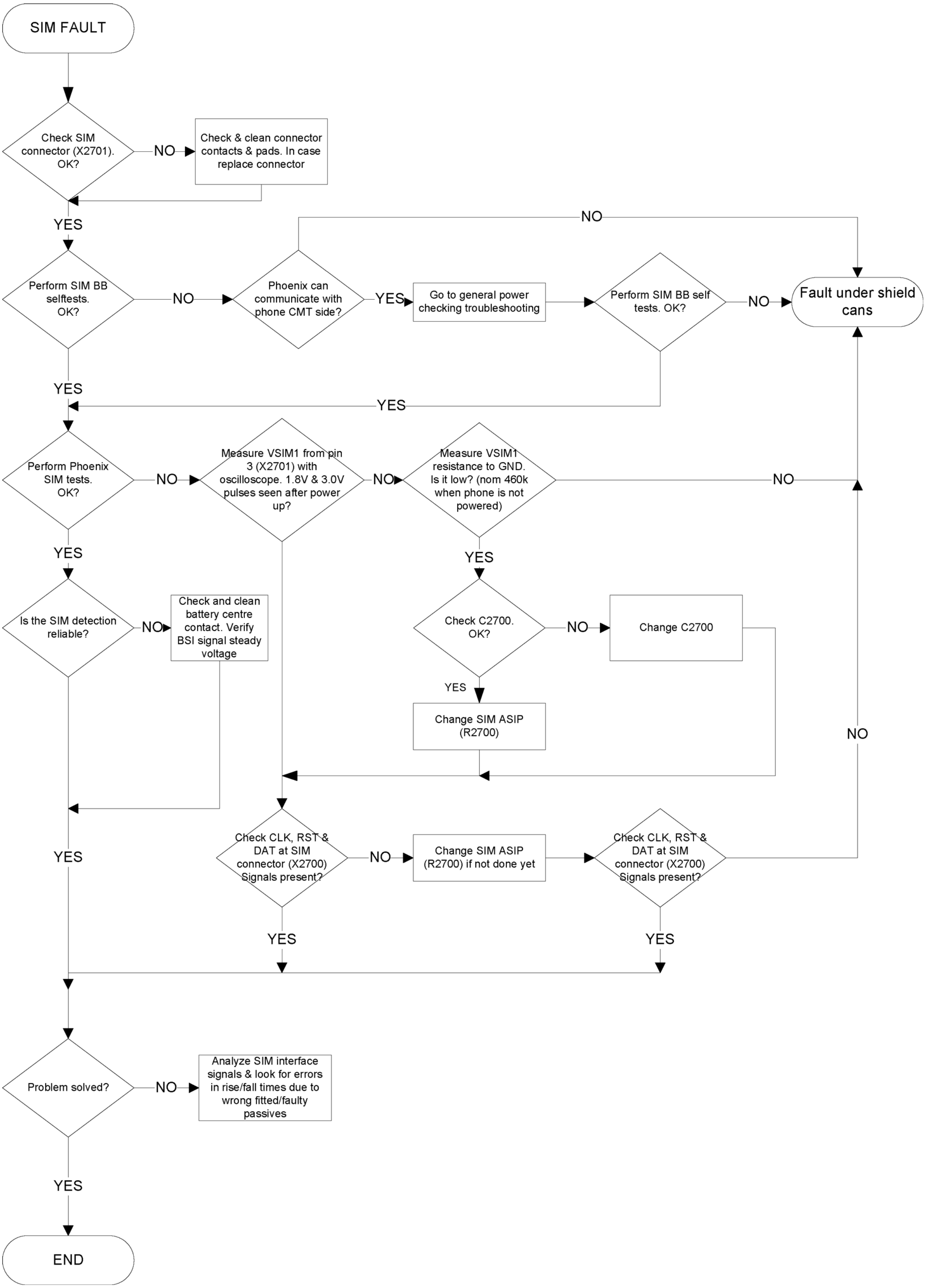
Power key troubleshooting

Troubleshooting flow


Power key does not work
Disassemble the phone. Check powerkey contacs and measure that power key is working. Check also battery contacts.
Key and contacts OK?
NO
Replace the damaged component
Place the phone into the module jig. Turn power on by connecting FPS-10 cable
Phone boots up normally
NO
Go to General power troubleshooting
YES
Measure voltage at J2416. Is it ~VBAT?
NO
Check R2415, C2415 and R2416. Replace the damaged component, it may be also EM ASIC (N2200) in which case phone will not be repaired. Resistance between J2416 and GND in unpowered phone is about 1 MOhms
YES
Problem solved?
NO
Go to general power checking troubleshooting
YES
END

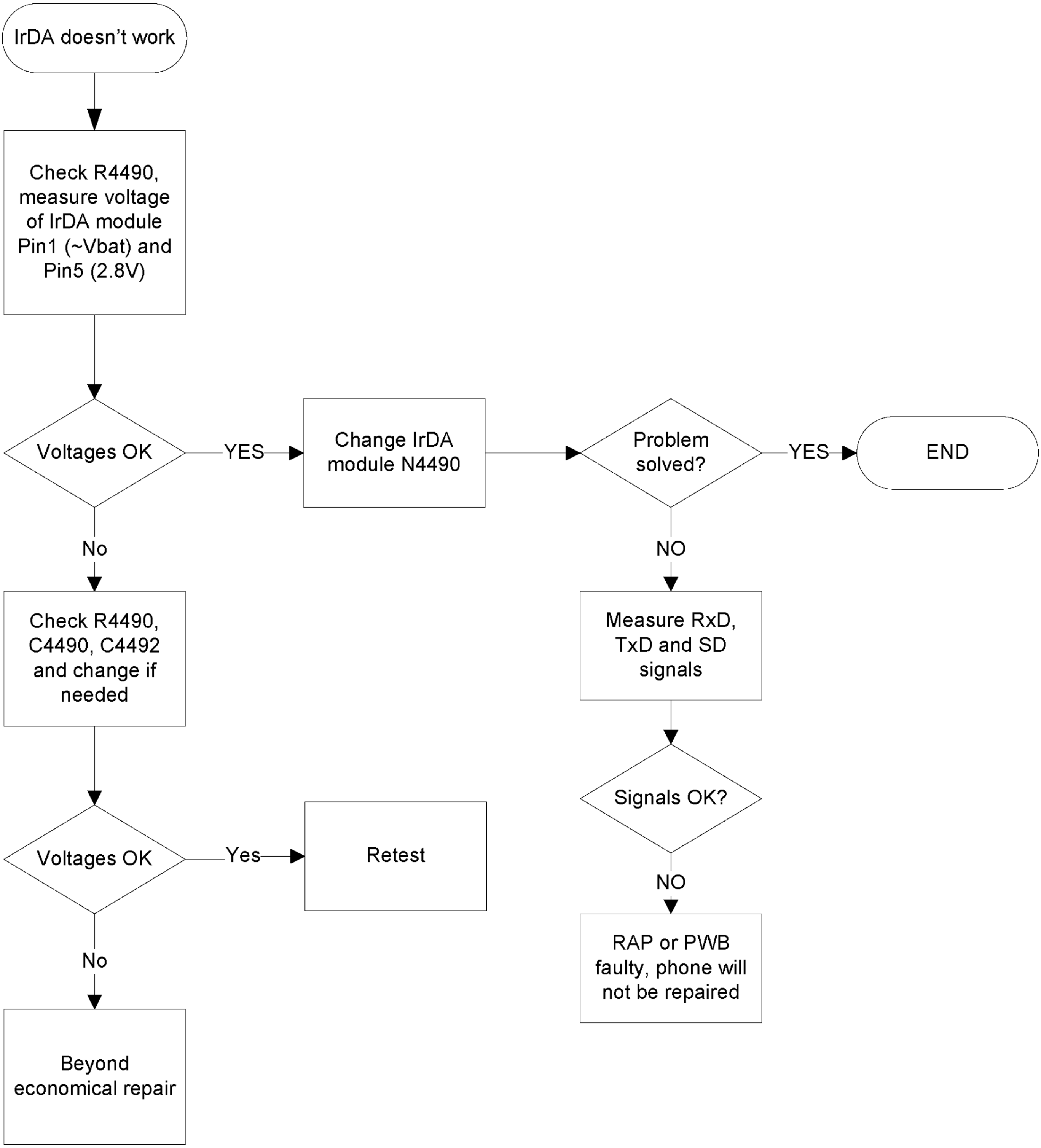
SIM troubleshooting

Troubleshooting flow


SIM FAULT
Check SIM connector (X2701). OK?
NO
Check & clean connector contacts & pads. In case replace connector
YES
NO
Perform SIM BB selftests. OK?
NO
Phoenix can communicate with phone CMT side?
YES
Go to general power checking troubleshooting
Perform SIM BB self tests. OK?
NO
Fault under shield cans
YES
YES
Perform Phoenix SIM tests. OK?
NO
Measure VSIM1 from pin 3 (X2701) with oscilloscope. 1.8V & 3.0V pulses seen after power up?
NO
Measure VSIM1 resistance to GND. Is it low? (nom 460k when phone is not powered)
NO
YES
YES
Is the SIM detection reliable?
NO
Check and clean battery centre contact. Verify BSI signal steady voltage
Check C2700. OK?
NO
Change C2700
YES
Change SIM ASIP (R2700)
NO
YES
Check CLK, RST & DAT at SIM connector (X2700) Signals present?
NO
Change SIM ASIP (R2700) if not done yet
Check CLK, RST & DAT at SIM connector (X2700) Signals present?
YES
YES
Problem solved?
NO
Analyze SIM interface signals & look for errors in rise/fall times due to wrong fitted/faulty passives
YES
END

Irda troubleshooting

Troubleshooting flow


IrDA doesn't work
Check R4490, measure voltage of IrDA module Pin1 (~Vbat) and Pin5 (2.8V)
Voltages OK
YES
Change IrDA module N4490
Problem solved?
YES
END
No
NO
Check R4490, C4490, C4492 and change if needed
Measure RxD, TxD and SD signals
Signals OK?
Voltages OK
Yes
Retest
NO
No
RAP or PWB faulty, phone will not be repaired
Beyond economical repair

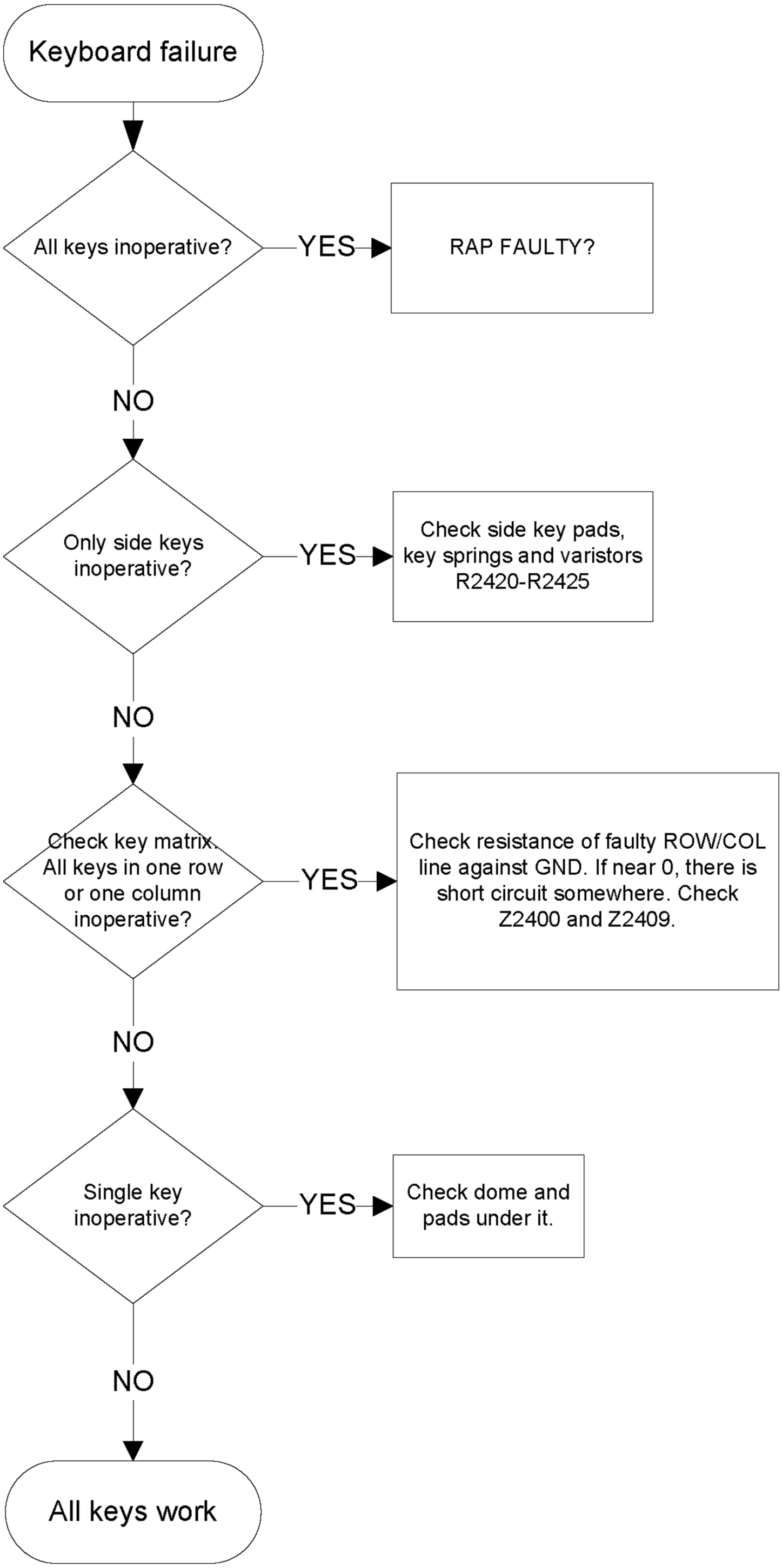
Keyboard troubleshooting

Context

There are two possible failure modes in the keyboard module: a) One or more keys can be stuck, so that the key does not react when a keydome is pressed. This kind of failure is caused by mechanical reasons (dirt, rust), b) Malfunction of several keys at the same time; this happens when one or more rows or columns are failing (shortcut or open connection).

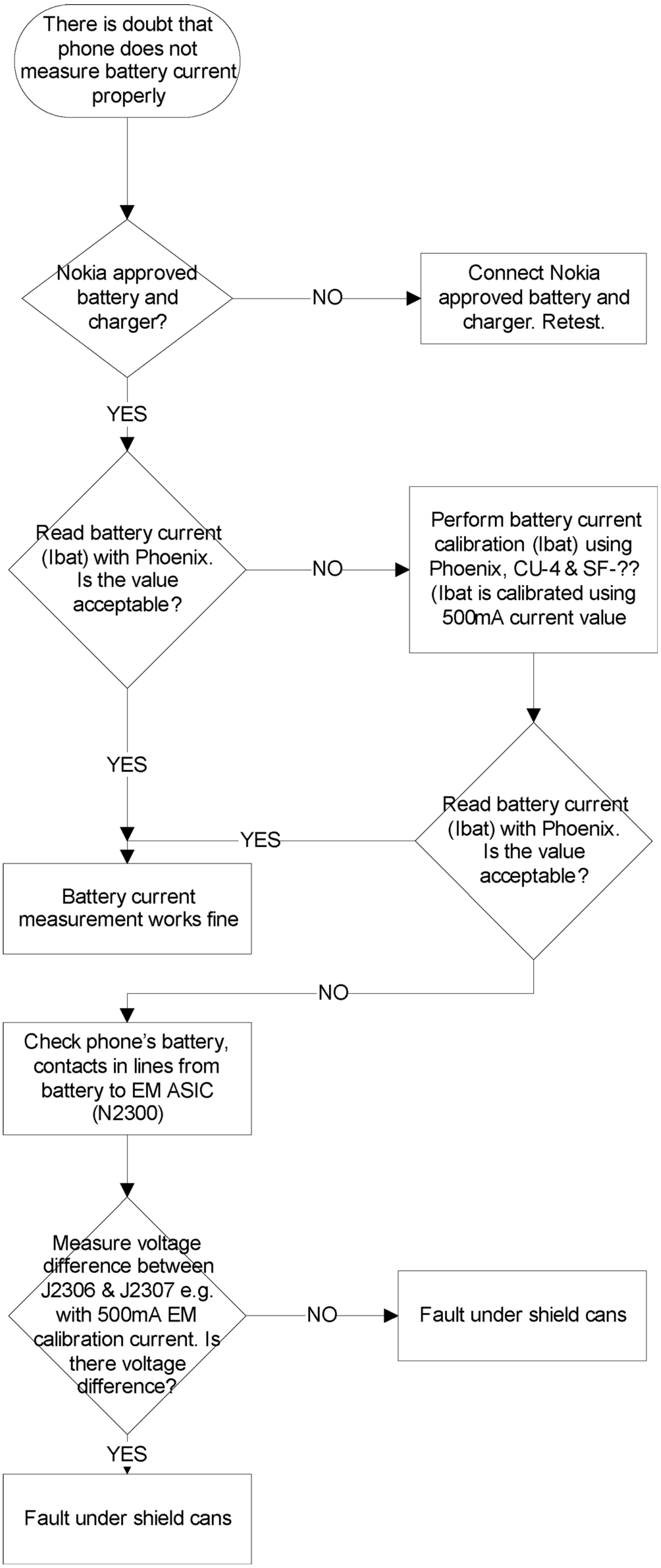
For a more detailed description of the keyboard and keymatrix, see section Keyboard. If the failure mode is not clear, start with the Keyboard Test in Phoenix.

Troubleshooting flow


Keyboard failure
All keys inoperative?
YES
RAP FAULTY?
NO
Only side keys inoperative?
YES
Check side key pads, key springs and varistors R2420-R2425
NO
Check key matrix. All keys in one row or one column inoperative?
YES
Check resistance of faulty ROW/COL line against GND. If near 0, there is short circuit somewhere. Check Z2400 and Z2409.
NO
Single key inoperative?
YES
Check dome and pads under it.
NO
All keys work

Battery current measuring fault troubleshooting

Troubleshooting flow


There is doubt that phone does not measure battery current properly
Nokia approved battery and charger?
NO
Connect Nokia approved battery and charger. Retest.
YES
Read battery current (Ibat) with Phoenix. Is the value acceptable?
NO
Perform battery current calibration (Ibat) using Phoenix, CU-4 & SF-?? (Ibat is calibrated using 500mA current value
YES
Read battery current (Ibat) with Phoenix. Is the value acceptable?
YES
Battery current measurement works fine
NO
Check phone's battery, contacts in lines from battery to EM ASIC (N2300)
Measure voltage difference between J2306 & J2307 e.g. with 500mA EM calibration current. Is there voltage difference?
NO
Fault under shield cans
YES
Fault under shield cans

Flash programming fault troubleshooting

Troubleshooting flow

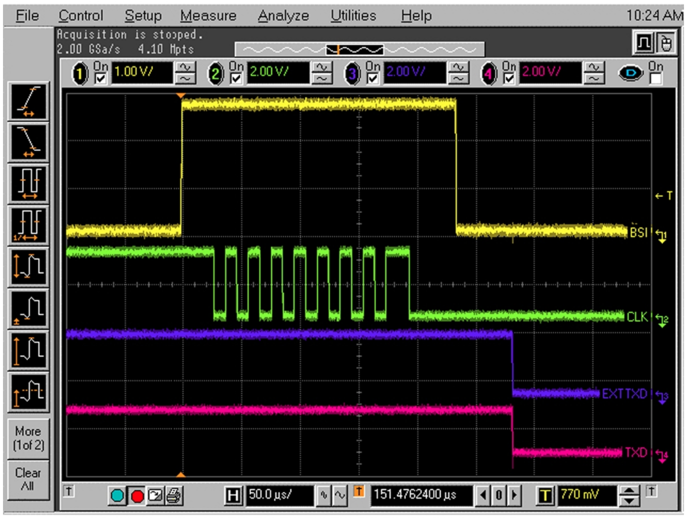

File
Control
Setup
Measure
Analyze
Utilities
Help
10:24 AM
Acquisition is stopped.
2.00 GSa/s 4.10 Mpts
1.00 V/
2.00 V/
2.00 V/
2.00 V/
BSI
CLK
EXTTXD
TXD
More (1of 2)
Clear All
50.0 µs/
151.4762400 µs
770 mV

Figure 38 Flashing pic 1. Take single trig measurement for the rise of the BSI signal.

Saved: 05 JUL 2004 13:24:19

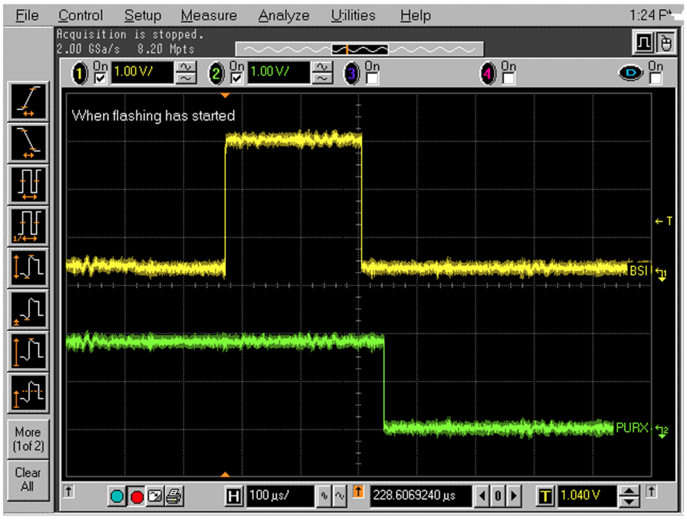

File
Control
Setup
Measure
Analyze
Utilities
Help
1:24 P
Acquisition is stopped.
2.00 GSa/s 8.20 Mpts
1.00 V/
1.00 V/
When flashing has started
BSI
PURX
More (1of 2)
Clear All
100 µs/
228.6069240 µs
1.040 V

Figure 39 Flashing pic 2. Take single trig measurement for the rise of the BSI signal.

Backup battery troubleshooting

First, verify that the backup battery is empty (i.e. the voltage of the backup battery is < 1 V). During this measurement the main battery must be disconnected and the phone must be switched OFF!

Then connect the main battery and switch the phone ON. Monitor the voltage of the backup battery in order to verify that the voltage will rise. After a few minutes switch the phone off and disconnect the main battery and measure that the backup battery is charged. Typical behaviour of the backup battery voltage during charge and discharge is described in the following pictures as a function of time.

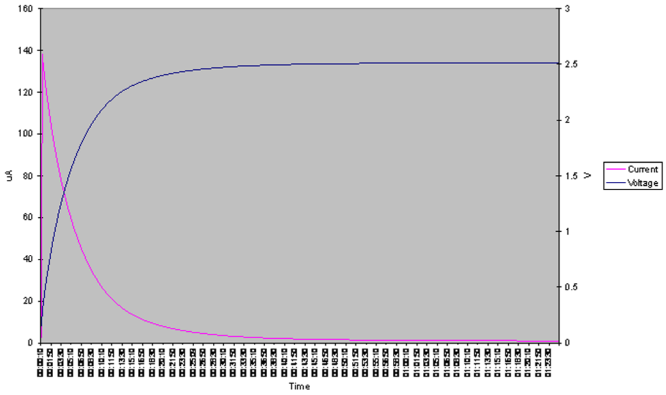


Figure 40 Charging backup battery

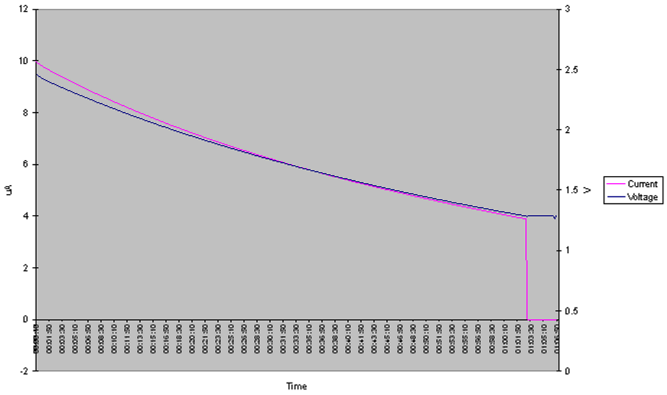


Figure 41 Discharging backup battery

If the voltage rises and falls quickly, battery is dead. If the voltage stays 0V, check resistance VBACK<-> GND: If there is no short circuit, Retu is faulty. Replace Retu.

Bluetooth troubleshooting

Introduction to Bluetooth troubleshooting

Bluetooth antenna is a conventional PWB antenna located beside the SIM card reader and it is not easily damaged.

The antenna feed capacitor is the only BT component outside shielding cans. All other components are under the can and BT ASIC is also underfilled, and thus cannot be repaired.

Malfunction in the BT ASIC, BT SMD components or in the baseband side is possible. This is unpredictable and could have many causes i.e. SE or HW related.

Bluetooth settings for Phoenix

Steps

1. Start *Phoenix* service software.

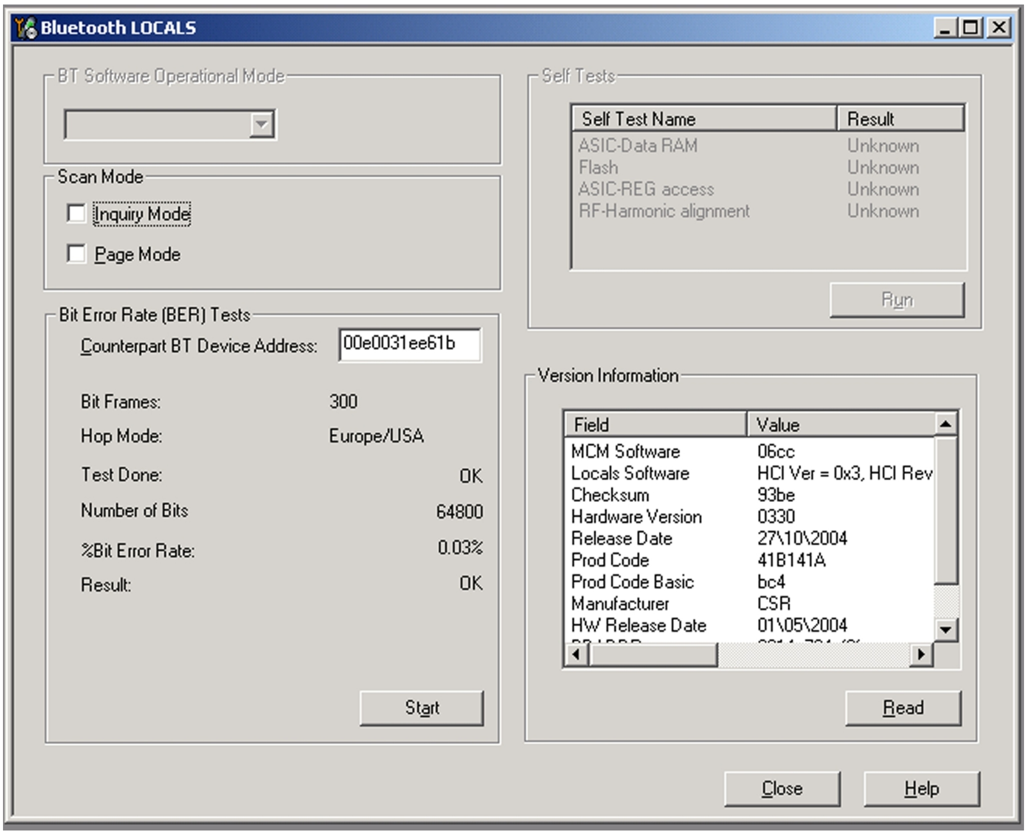
2. From the **File** menu, choose **Open Product**, and then choose the correct type designator from the **Product** list.
3. Place the phone to a flash adapter in the local mode.
4. Choose **Testing→Bluetooth LOCALS** .
5. Locate JBT-9’s serial number (12 digits) found in the type label on the back of JBT-9.

   In addition to JBT-9, also SB-6, JBT-3 and JBT-6 Bluetooth test boxes can be used.
6. In the *Bluetooth LOCALS* window, write the 12-digit serial number on the **Counterpart BT Device Address** line.

   This needs to be done only once provided that JBT-9 is not changed.
7. Place the JBT-9 box near (within 10 cm) the BT antenna and click **Run BER Test**.

Results

Bit Error Rate test result is displayed in the *Bit Error Rate (BER) Tests* pane in the *Bluetooth LOCALS* window.



Counterpart BT Device Address: 00e0031ee61b

Bit Frames: 300

Hop Mode: Europe/USA

Test Done: OK

Number of Bits: 64800

%Bit Error Rate: 0.03%

Result: OK

Self Test Name	Result
ASIC-Data RAM	Unknown
Flash	Unknown
ASIC-REG access	Unknown
RF-Harmonic alignment	Unknown

Field	Value
MCM Software	06cc
Locals Software	HCI Ver = 0x3, HCI Rev
Checksum	93be
Hardware Version	0330
Release Date	27\10\2004
Prod Code	41B141A
Prod Code Basic	bc4
Manufacturer	CSR
HW Release Date	01\05\2004

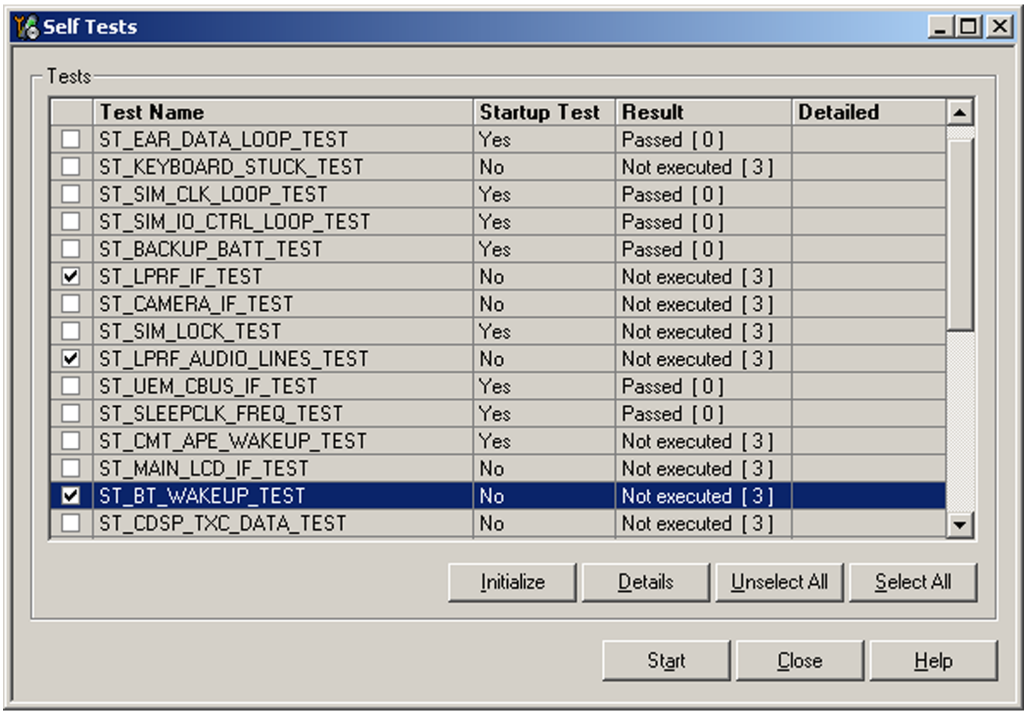
Figure 42 BER test result

Bluetooth self tests in Phoenix

Steps

1. Start *Phoenix* service software.
2. Choose**File→Scan Product.**
3. Place the phone to a flash adapter.
4. From the **Mode** drop-down menu, set mode to **Local**.
5. Choose **Testing→Self Tests.**

6. In the *Self Tests* window check the following Bluetooth related tests:
   - **ST_LPRF_AUDIO_LINES_TEST**
   - **ST_BT_WAKEUP_TEST**
7. To run the tests, click **Start**.

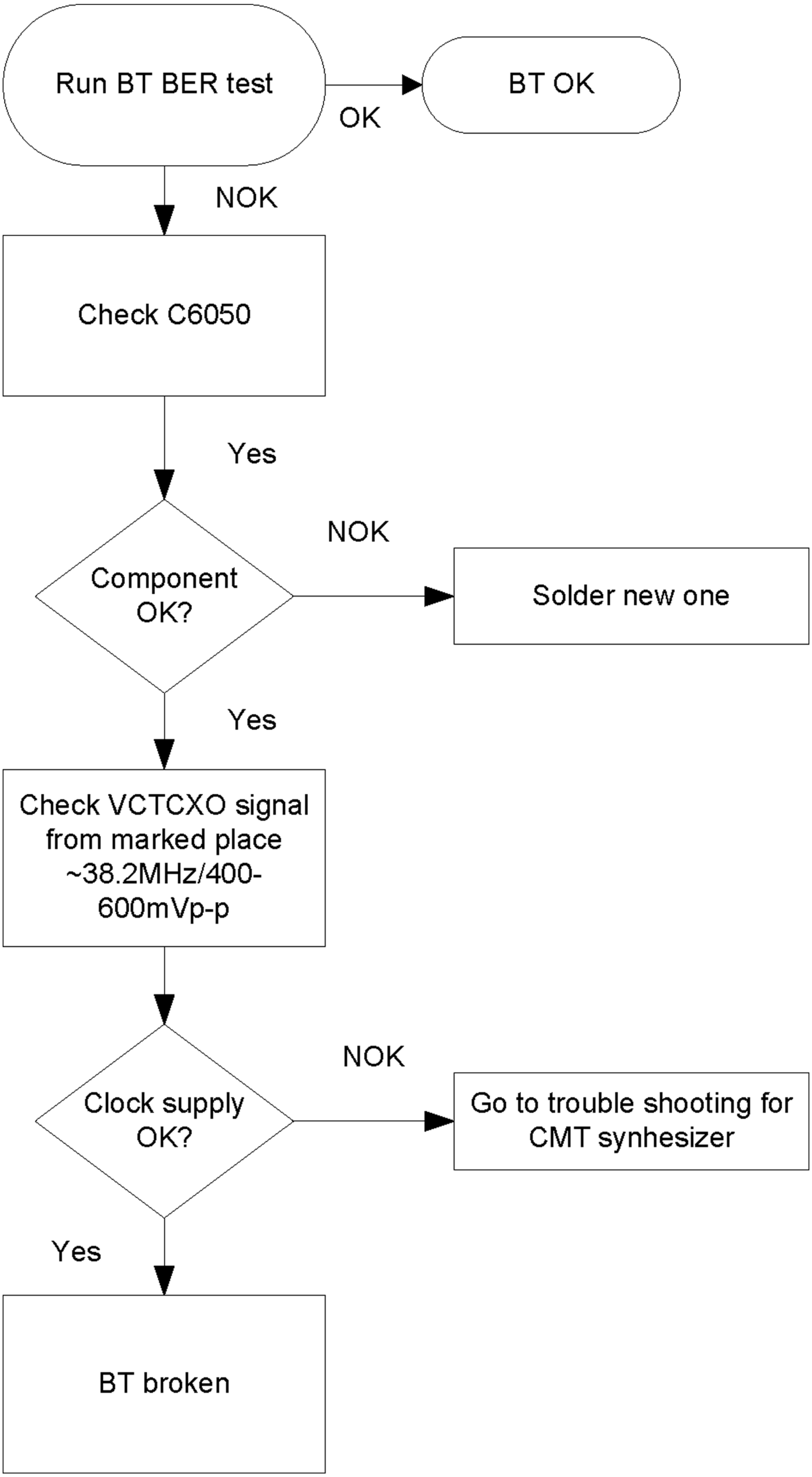


	Test Name	Startup Test	Result	Detailed
☐	ST_EAR_DATA_LOOP_TEST	Yes	Passed [0]	
☐	ST_KEYBOARD_STUCK_TEST	No	Not executed [3]	
☐	ST_SIM_CLK_LOOP_TEST	Yes	Passed [0]	
☐	ST_SIM_IO_CTRL_LOOP_TEST	Yes	Passed [0]	
☐	ST_BACKUP_BATT_TEST	Yes	Passed [0]	
☑	ST_LPRF_IF_TEST	No	Not executed [3]	
☐	ST_CAMERA_IF_TEST	No	Not executed [3]	
☐	ST_SIM_LOCK_TEST	Yes	Not executed [3]	
☑	ST_LPRF_AUDIO_LINES_TEST	No	Not executed [3]	
☐	ST_UEM_CBUS_IF_TEST	Yes	Passed [0]	
☐	ST_SLEEPCLK_FREQ_TEST	Yes	Passed [0]	
☐	ST_CMT_APE_WAKEUP_TEST	Yes	Not executed [3]	
☐	ST_MAIN_LCD_IF_TEST	No	Not executed [3]	
☑	ST_BT_WAKEUP_TEST	No	Not executed [3]	
☐	ST_CDSP_TXC_DATA_TEST	No	Not executed [3]	

Figure 43 Bluetooth self tests in *Phoenix*

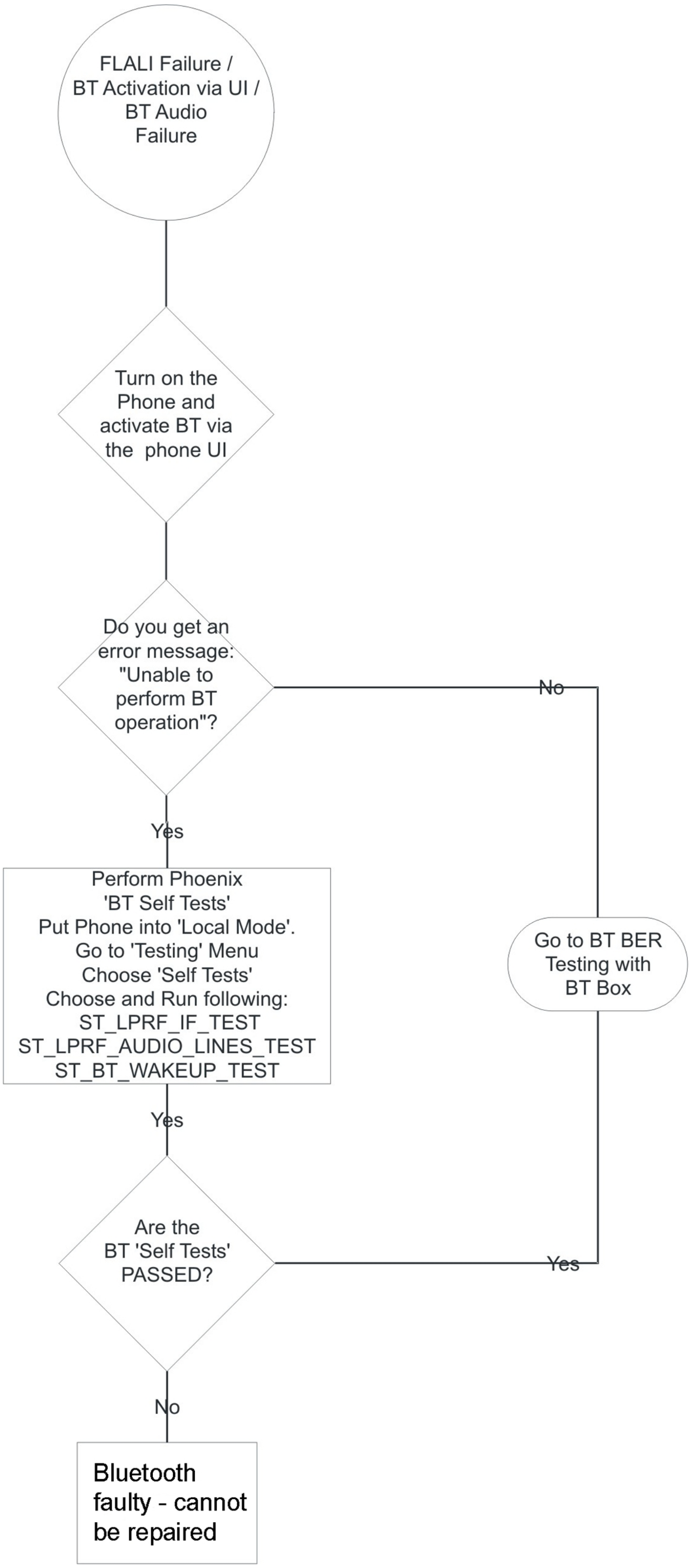
Bluetooth BER failure troubleshooting

Troubleshooting flow


Run BT BER test
OK
BT OK
NOK
Check C6050
Yes
Component OK?
NOK
Solder new one
Yes
Check VCTCXO signal from marked place ~38.2MHz/400-600mVp-p
Clock supply OK?
NOK
Go to trouble shooting for CMT synhesizer
Yes
BT broken

BT audio failure troubleshooting

Troubleshooting flow


FLALI Failure / BT Activation via UI / BT Audio Failure
Turn on the Phone and activate BT via the phone UI
Do you get an error message: "Unable to perform BT operation"?
No
Yes
Perform Phoenix 'BT Self Tests'
Put Phone into 'Local Mode'.
Go to 'Testing' Menu
Choose 'Self Tests'
Choose and Run following:
ST_LPRF_IF_TEST
ST_LPRF_AUDIO_LINES_TEST
ST_BT_WAKEUP_TEST
Go to BT BER Testing with BT Box
Yes
Are the BT 'Self Tests' PASSED?
Yes
No
Bluetooth faulty - cannot be repaired

■ Audio troubleshooting

Audio troubleshooting test instructions

Differential external earpiece and internal earpiece outputs can be measured either with a single-ended or a differential probe.

When measuring with a single-ended probe each output is measured against the ground.

Internal handsfree output is measured using a current probe, if a special low-pass filter designed for measuring a digital amplifier is not available. Note also that when using a current probe, the input signal frequency must be set to 2kHz.

The input signal for each loop test can be either single-ended or differential.

Required equipment

The following equipment is needed for the tests:

- Oscilloscope
- Function generator (sine waveform)
- Current probe (Internal handsfree PWM output measurement)
- Phoenix service software
- Battery voltage 3.7V

Test procedure

Audio can be tested using the Phoenix audio routings option. Three different audio loop paths can be activated:

- External microphone to Internal earpiece
- External microphone to Internal handsfree speaker
- Internal microphone to External earpiece

Each audio loop sets routing from the specified input to the specified output enabling a quick in-out test. Loop path gains are fixed and they cannot be changed using Phoenix. Correct pins and signals for each test are presented in the following table.

Phoenix audio loop tests and test results

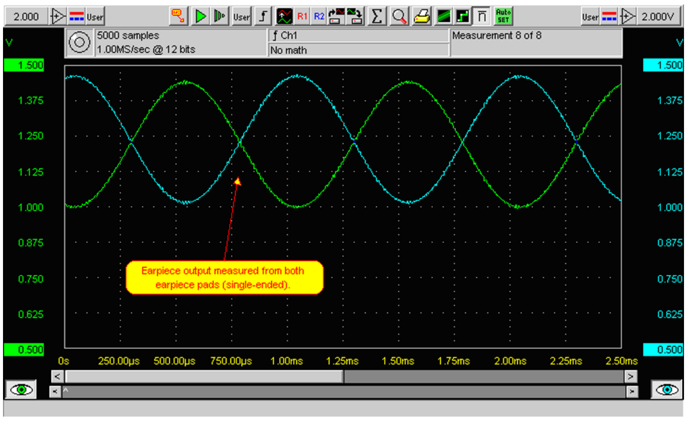
The results presented in the table apply when no accessory is connected and battery voltage is set to 3.7V.

Earpiece, internal microphone and speaker are in place during measurement. Applying a headset accessory during measurement causes a significant drop in measured quantities.

The gain values presented in the table apply for a differential output vs. single-ended/differential input.

Loop test	Input terminal	Output terminal	Path gain [dB] (fixed)	Input voltage [mVp-p]	Differential output voltage [mVp-p]	Output DC level [V]	Output current [mA]
External Mic to External Earpiece	XMICP and GND	HSEAR R P, HSEAR R N and GND	-2.9	1000	720	1.2	NA
		HSEAR P, HSEAR N and GND					
	XMICN and GND	HSEAR R P, HSEAR R N and GND					
		HSEAR P, HSEAR N and GND					
External Mic to Internal Earpiece	XMICP and GND	EarP and GND	-4.5	1000	600	1.2	NA
		EarN and GND					
	XMICN and GND	EarP and GND					
		EarN and GND					
External Mic to Internal handsfree	XMICP and GND	B2102 pads	-5	1000	560	0	25mA (calc.)
	XMICN and GND	B2102 pads					
Internal Mic to External Earpiece	B2100 (OUT/ GND)	HSEAR R P, HSEAR R N and GND	22.7	100	1360	1.2	NA
		HSEAR P, HSEAR N and GND					
		HSEAR R P, HSEAR R N and GND					
		HSEAR P, HSEAR N and GND					

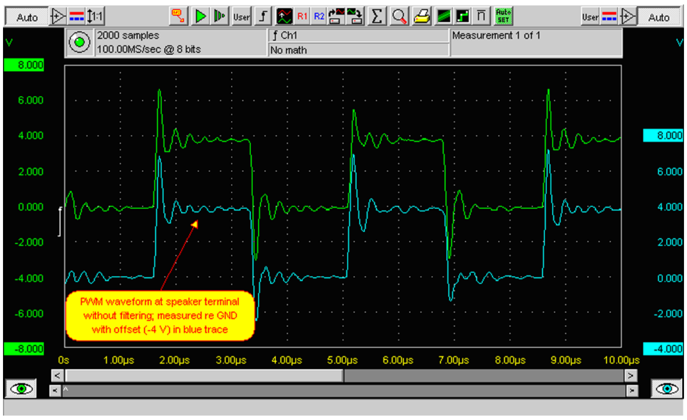
Measurement data


5000 samples
1.00MS/sec @ 12 bits
ƒ Ch1
No math
Measurement 8 of 8

Earpiece output measured from both earpiece pads (single-ended).

2.000
2.000V
V
1.500
1.375
1.250
1.125
1.000
0.875
0.750
0.625
0.500
0s
250.00µs
500.00µs
750.00µs
1.00ms
1.25ms
1.50ms
1.75ms
2.00ms
2.25ms
2.50ms

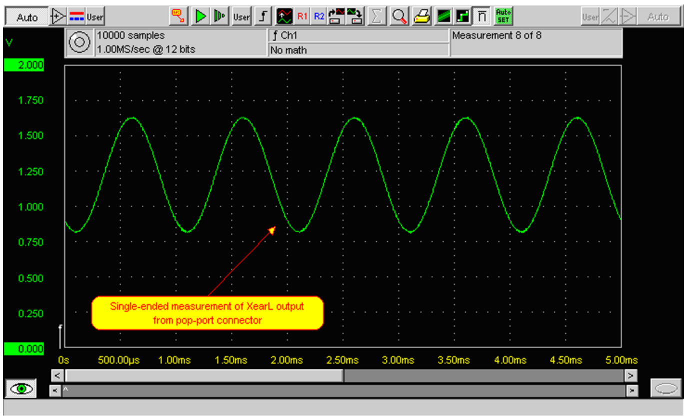
Figure 44 Single-ended output waveform of the Ext_in_HP_out measurement when earpiece is connected.


2000 samples
100.00MS/sec @ 8 bits
ƒ Ch1
No math
Measurement 1 of 1

PWM waveform at speaker terminal without filtering; measured re GND with offset (-4 V) in blue trace

Auto
Auto
V
8.000
6.000
4.000
2.000
0.000
-2.000
-4.000
-6.000
-8.000
8.000
6.000
4.000
2.000
0.000
-2.000
-4.000
0s
1.00µs
2.00µs
3.00µs
4.00µs
5.00µs
6.00µs
7.00µs
8.00µs
9.00µs
10.00µs

Figure 45 Differential output waveform of the Ext_in_IHF_out out loop measurement when speaker is connected.


10000 samples
1.00MS/sec @ 12 bits
ƒ Ch1
No math
Measurement 8 of 8

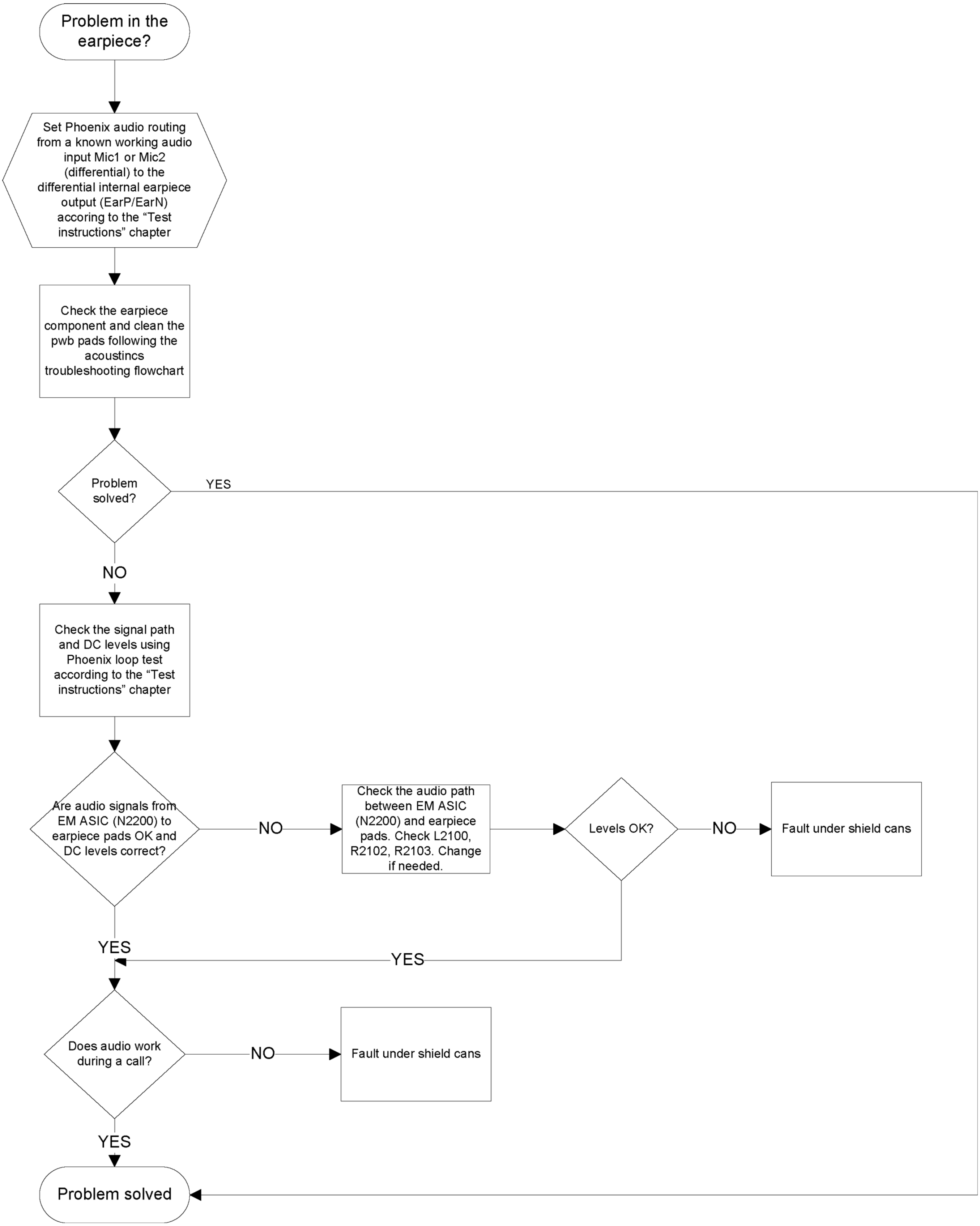
Single-ended measurement of XearL output from pop-port connector

Auto
V
2.000
1.750
1.500
1.250
1.000
0.750
0.500
0.250
0.000
0s
500.00µs
1.00ms
1.50ms
2.00ms
2.50ms
3.00ms
3.50ms
4.00ms
4.50ms
5.00ms

Figure 46 Single-ended output waveform of the HP_in_Ext_out loop when microphone is connected.

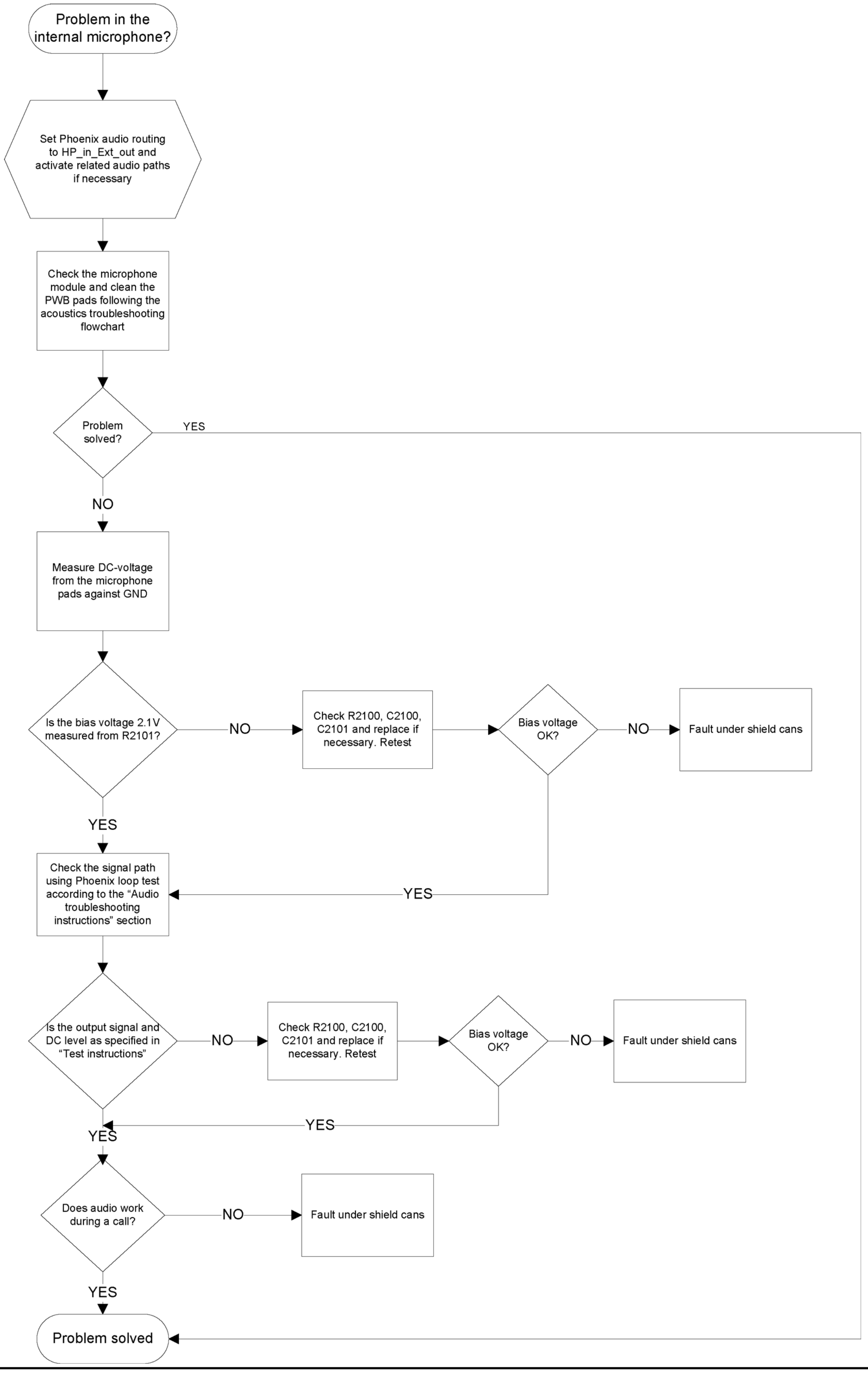
Internal earpiece troubleshooting

Troubleshooting flow


Problem in the earpiece?
Set Phoenix audio routing from a known working audio input Mic1 or Mic2 (differential) to the differential internal earpiece output (EarP/EarN) accoring to the “Test instructions” chapter
Check the earpiece component and clean the pwb pads following the acoustincs troubleshooting flowchart
Problem solved?
YES
NO
Check the signal path and DC levels using Phoenix loop test according to the “Test instructions” chapter
Are audio signals from EM ASIC (N2200) to earpiece pads OK and DC levels correct?
NO
Check the audio path between EM ASIC (N2200) and earpiece pads. Check L2100, R2102, R2103. Change if needed.
Levels OK?
NO
Fault under shield cans
YES
YES
Does audio work during a call?
NO
Fault under shield cans
YES
Problem solved

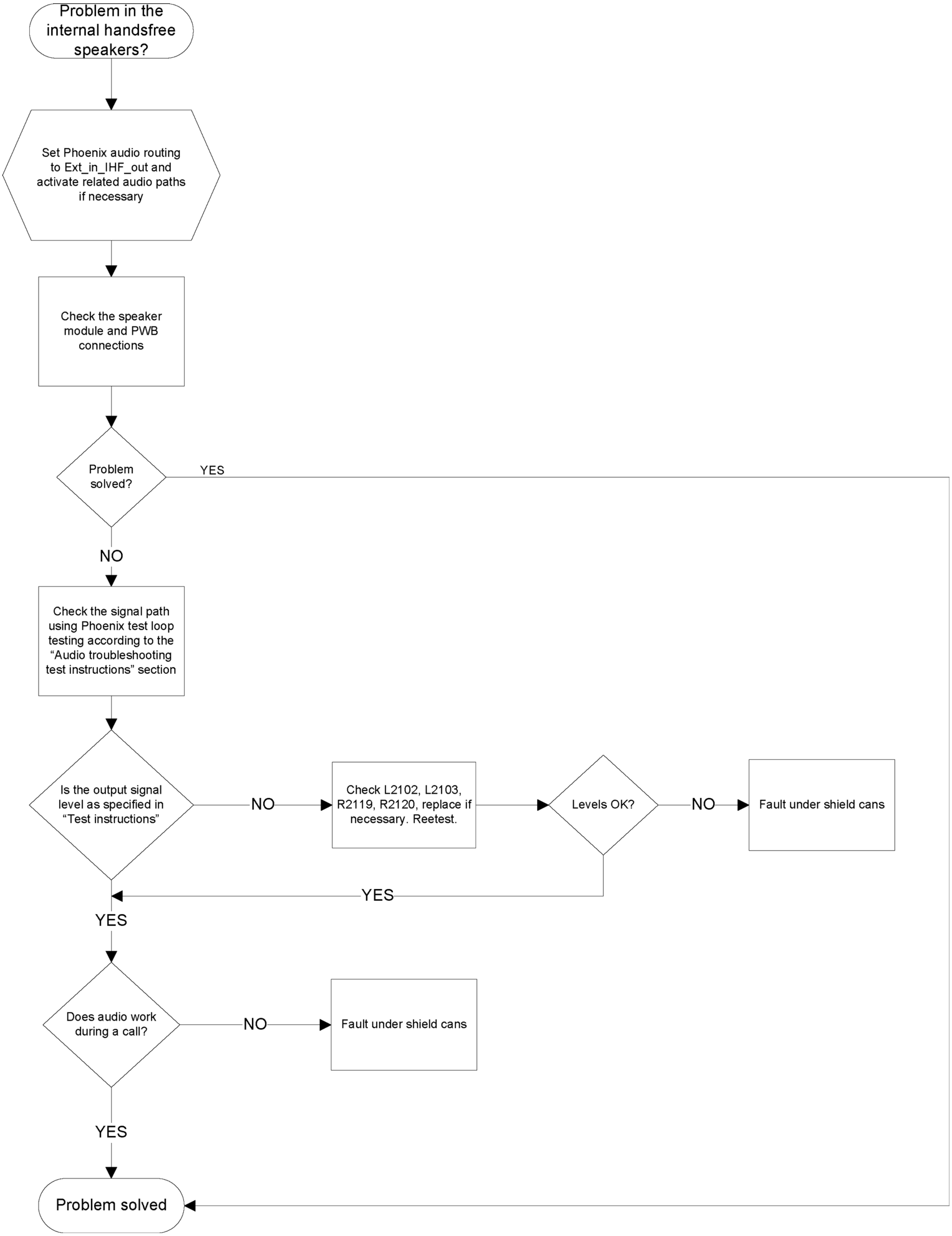
Internal microphone troubleshooting

Troubleshooting flow


Problem in the internal microphone?
Set Phoenix audio routing to HP_in_Ext_out and activate related audio paths if necessary
Check the microphone module and clean the PWB pads following the acoustics troubleshooting flowchart
Problem solved?
YES
NO
Measure DC-voltage from the microphone pads against GND
Is the bias voltage 2.1V measured from R2101?
NO
Check R2100, C2100, C2101 and replace if necessary. Retest
Bias voltage OK?
NO
Fault under shield cans
YES
Check the signal path using Phoenix loop test according to the "Audio troubleshooting instructions" section
YES
Is the output signal and DC level as specified in "Test instructions"
NO
Check R2100, C2100, C2101 and replace if necessary. Retest
Bias voltage OK?
NO
Fault under shield cans
YES
YES
Does audio work during a call?
NO
Fault under shield cans
YES
Problem solved

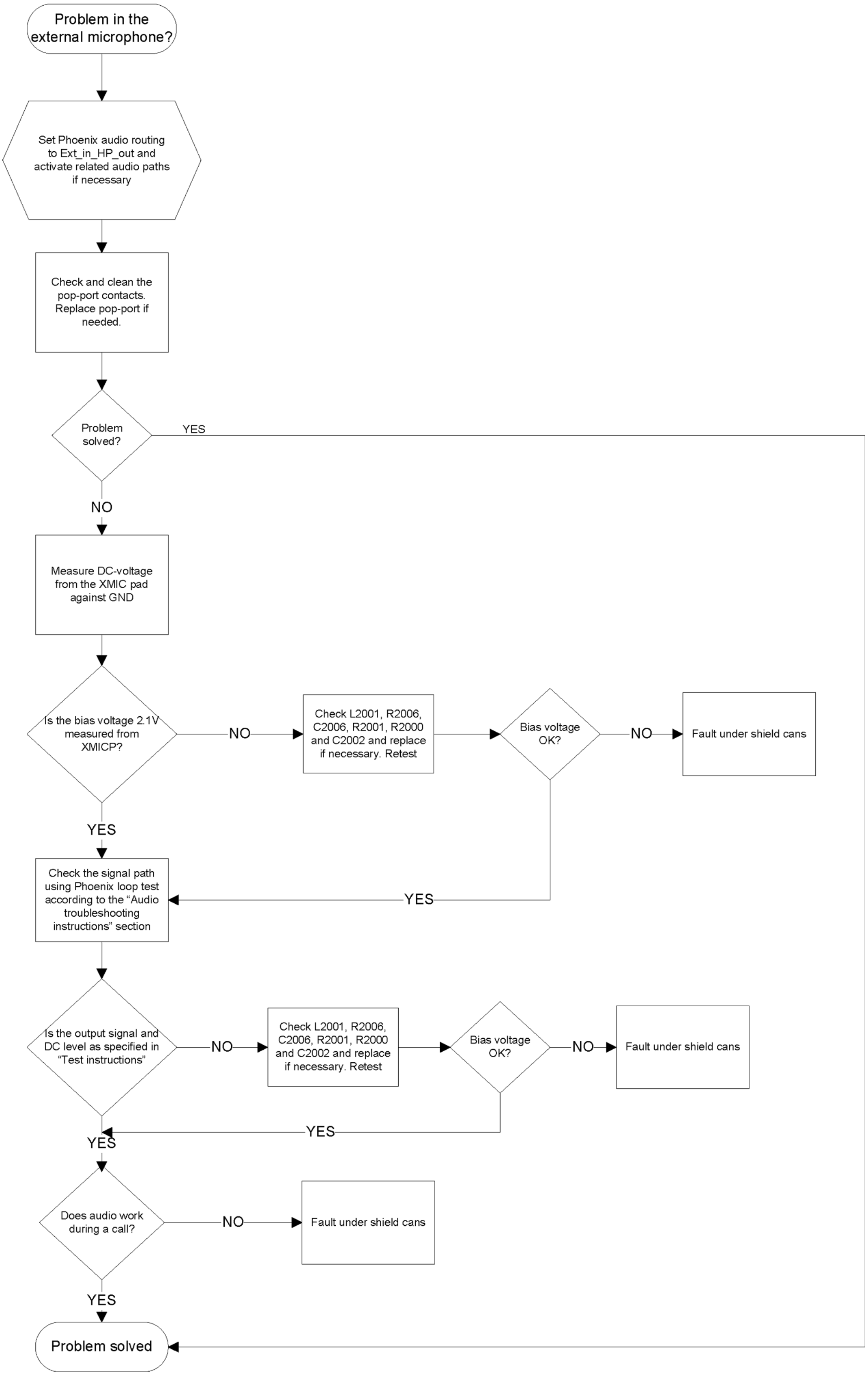
IHF troubleshooting

Troubleshooting flow


Problem in the internal handsfree speakers?
Set Phoenix audio routing to Ext_in_IHF_out and activate related audio paths if necessary
Check the speaker module and PWB connections
Problem solved?
YES
NO
Check the signal path using Phoenix test loop testing according to the "Audio troubleshooting test instructions" section
Is the output signal level as specified in "Test instructions"
NO
Check L2102, L2103, R2119, R2120, replace if necessary. Reetest.
Levels OK?
NO
Fault under shield cans
YES
YES
Does audio work during a call?
NO
Fault under shield cans
YES
Problem solved

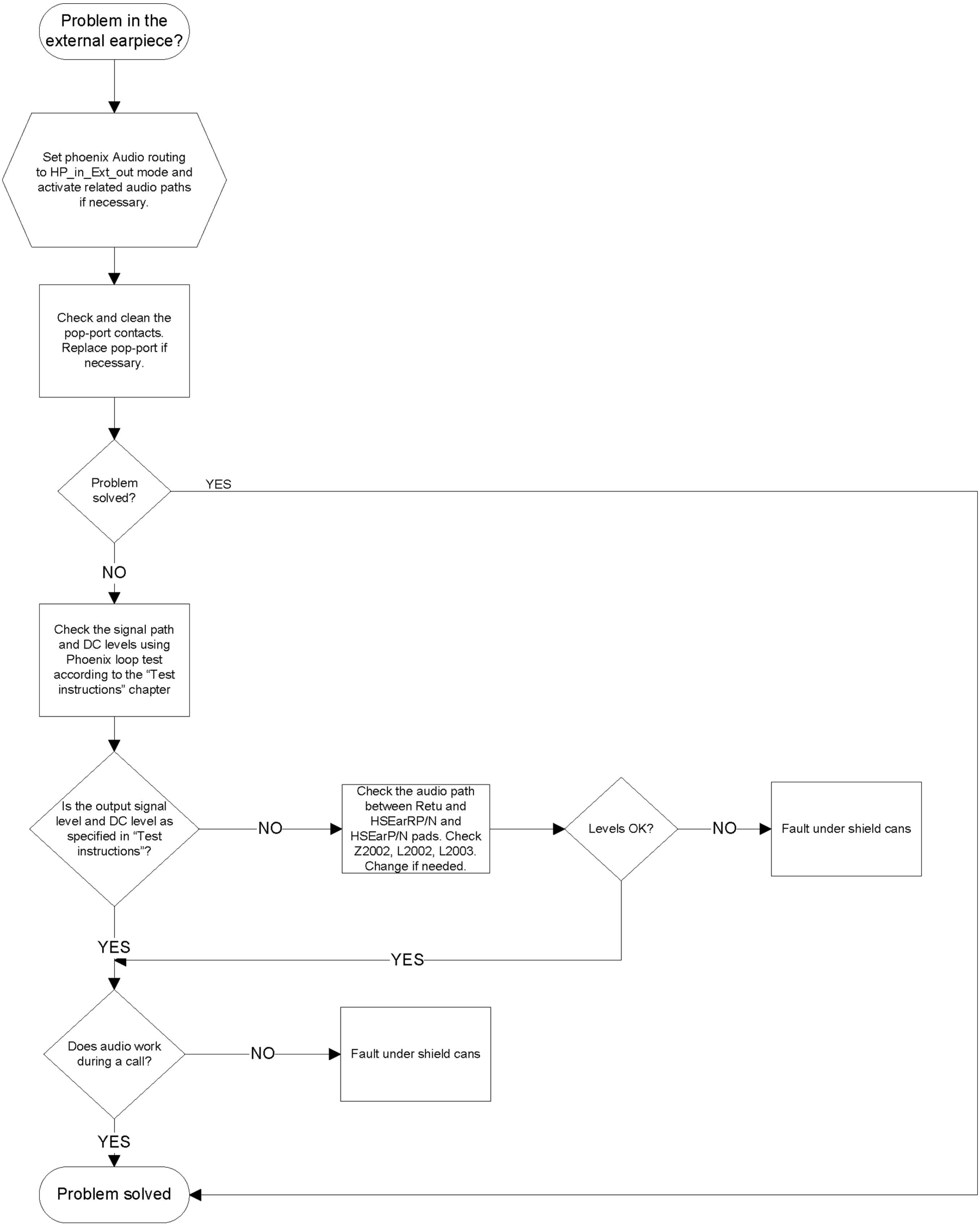
External microphone troubleshooting

Troubleshooting flow


Problem in the external microphone?
Set Phoenix audio routing to Ext_in_HP_out and activate related audio paths if necessary
Check and clean the pop-port contacts. Replace pop-port if needed.
Problem solved?
YES
NO
Measure DC-voltage from the XMIC pad against GND
Is the bias voltage 2.1V measured from XMICP?
NO
Check L2001, R2006, C2006, R2001, R2000 and C2002 and replace if necessary. Retest
Bias voltage OK?
NO
Fault under shield cans
YES
YES
Check the signal path using Phoenix loop test according to the "Audio troubleshooting instructions" section
Is the output signal and DC level as specified in "Test instructions"
NO
Check L2001, R2006, C2006, R2001, R2000 and C2002 and replace if necessary. Retest
Bias voltage OK?
NO
Fault under shield cans
YES
YES
Does audio work during a call?
NO
Fault under shield cans
YES
Problem solved

External earpiece troubleshooting

Troubleshooting flow


Problem in the external earpiece?
Set phoenix Audio routing to HP_in_Ext_out mode and activate related audio paths if necessary.
Check and clean the pop-port contacts. Replace pop-port if necessary.
Problem solved?
YES
NO
Check the signal path and DC levels using Phoenix loop test according to the "Test instructions" chapter
Is the output signal level and DC level as specified in "Test instructions"?
NO
Check the audio path between Retu and HSEarRP/N and HSEarP/N pads. Check Z2002, L2002, L2003. Change if needed.
Levels OK?
NO
Fault under shield cans
YES
YES
Does audio work during a call?
NO
Fault under shield cans
YES
Problem solved

Introduction to acoustics troubleshooting

Acoustics troubleshooting

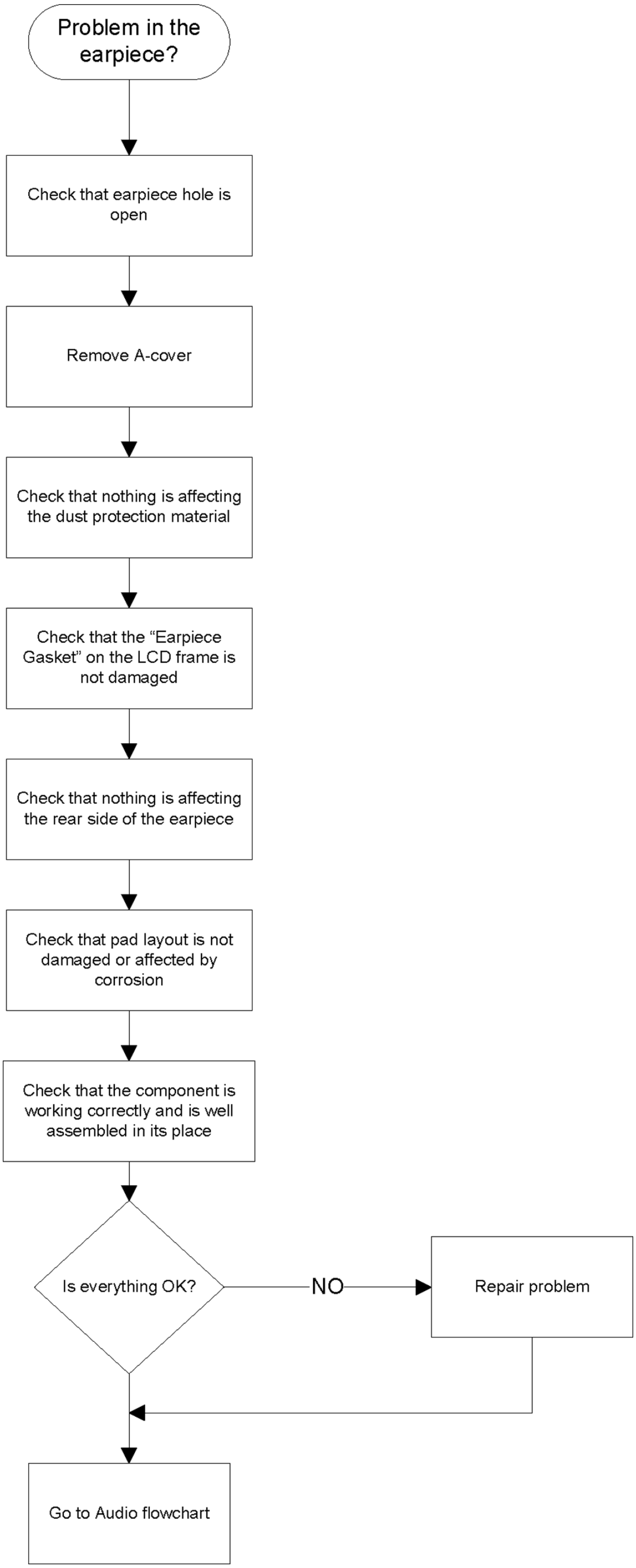
Acoustics design ensures that the sound is detected correctly with a microphone and properly radiated to the outside of the device by speaker(s). The acoustics of the phone includes three basic systems: earpiece, Integrated Hands Free (IHF) and microphone.

The sound reproduced from the earpiece readiates through a single hole on the front cover (A-cover). The sound reproduced from the IHF speakers radiates from left and right sound holes located on both sides of the device. Microphone is located at the bottom, next to the system connector.

For a correct functionality of the phone, all sound holes must be always open. When the phone is used, care must be taken not to close any of those holes with a hand or fingers. The phone should be dry and clean, and no objects must be located in such a way that they close any of the holes.

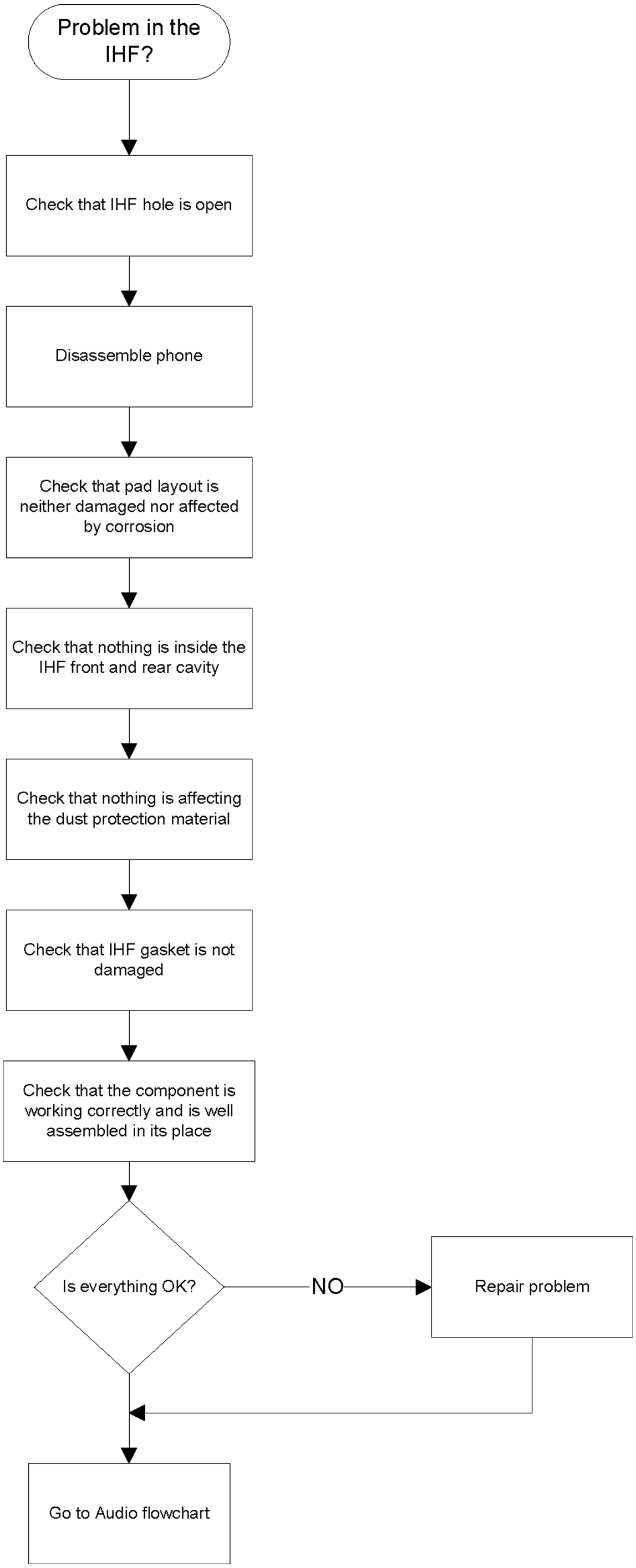
Acoustics earpiece troubleshooting

Troubleshooting flow


Problem in the earpiece?
Check that earpiece hole is open
Remove A-cover
Check that nothing is affecting the dust protection material
Check that the “Earpiece Gasket” on the LCD frame is not damaged
Check that nothing is affecting the rear side of the earpiece
Check that pad layout is not damaged or affected by corrosion
Check that the component is working correctly and is well assembled in its place
Is everything OK?
NO
Repair problem
Go to Audio flowchart

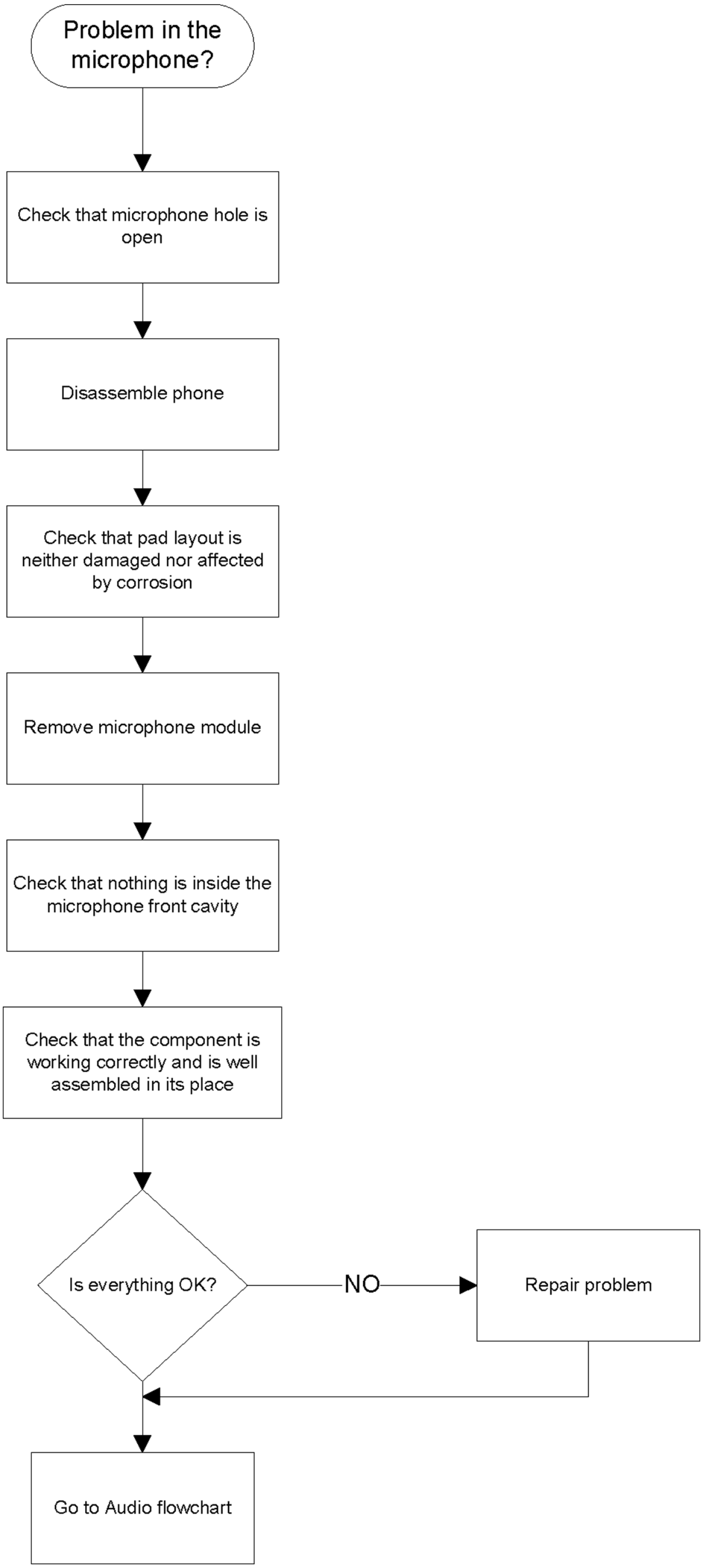
Acoustics IHF troubleshooting

Troubleshooting flow


Problem in the IHF?
Check that IHF hole is open
Disassemble phone
Check that pad layout is neither damaged nor affected by corrosion
Check that nothing is inside the IHF front and rear cavity
Check that nothing is affecting the dust protection material
Check that IHF gasket is not damaged
Check that the component is working correctly and is well assembled in its place
Is everything OK?
NO
Repair problem
Go to Audio flowchart

Acoustics microphone troubleshooting

Troubleshooting flow


Problem in the microphone?
Check that microphone hole is open
Disassemble phone
Check that pad layout is neither damaged nor affected by corrosion
Remove microphone module
Check that nothing is inside the microphone front cavity
Check that the component is working correctly and is well assembled in its place
Is everything OK?
NO
Repair problem
Go to Audio flowchart

Baseband manual tuning guide

Energy management calibration

Prerequisites

Energy Management (EM) calibration is performed to calibrate the setting (gain and offset) of AD converters in several channels (that is, **battery voltage**, **BSI**, **battery current**) to get an accurate AD conversion result.

Hardware setup:

- An external power supply is needed.
- Supply 12V DC from an external power supply to CU-4 to power up the phone.
- The phone must be connected to a CU-4 control unit with a product-specific flash adapter.

Steps

1. Place the phone to the docking station adapter (CU-4 is connected to the adapter).
2. Start *Phoenix* service software.
3. Choose **File→ Scan Product.**
4. Choose **Tuning→Energy Management Calibration.**
5. To show the current values in the phone memory, click **Read**, and check that communication between the phone and CU-4 works.
6. Check that the **CU-4 used** check box is checked.
7. Select the item(s) to be calibrated.

   Note: ADC calibration has to be performed before other item(s). However, if all calibrations are selected at the same time, there is no need to perform the ADC calibration first.

8. Click **Calibrate**.

   The calibration of the selected item(s) is carried out automatically.

   The candidates for the new calibration values are shown in the *Calculated values* column. If the new calibration values seem to be acceptable (please refer to the following "Calibration value limits" table), click **Write** to store the new calibration values to the phone permanent memory.

Table 9 Calibration value limits

Parameter	Min.	Max.
ADC Offset	-20	20
ADC Gain	12000	14000
BSI Gain	1100	1300
VBAT Offset	2400	2650
VBAT Gain	19000	23000
IBAT (ICal) Gain	5750	12250

9. Click **Read**, and confirm that the new calibration values are stored in the phone memory correctly. If the values are not stored to the phone memory, click **Write** and/or repeat the procedure again.
10. To end the procedure, close the *Energy Management Calibration* window.

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7 — RF Troubleshooting and Manual Tuning Guide

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Introduction to RF troubleshooting

All measurements should be done using:

- spectrum analyser with a high-frequency high-impedance passive probe (LO-/reference frequencies and RF power levels)
- oscilloscope with a 10:1 probe (DC-voltages and low frequency signals)

> **Caution:** Also all measurements with an RF coupler should be performed in RF shielded environment because nearby base stations can disturb sensitive receiver measurements. If there is no possibility to use RF shielded environment, it should be checked that there are no transmissions on the same frequencies as used in the tests.

The RF section of the phone is build around one RF ASIC: ASIC N7505.

> **Note:** Before changing N7505, please check the following things: supply voltages and serial communication coming from baseband toN7505 are OK. Please note that the grounding of the Frond End Module (FEM) is directly below FEM so it is difficult to check or change.

Most RF semiconductors are static discharge sensitive! ESD protection must be taken care of during repair (ground straps and ESD soldering irons). N7505 and FEM are moisture sensitive, so parts must be pre-baked prior to soldering.

In addition to key components, there are lot of discrete components (resistors, inductors and capacitors) which troubleshooting is done mainly by checking if the soldering of the component is done properly.

Capacitor can be checked for shorts and resistors for value by means of an ohmmeter, but be aware in-circuit measurements should be evaluated carefully as other components connected to the same node can change the seen resistance.

Keep in mind that all measured voltages or RF levels depicted in the service manual are rough figures. Especially RF levels vary because of different measuring equipment or different grounding of the probe used.

When using an RF probe, use a pair of metallic tweezers to connect the probe ground to the PWB ground as close to the measurement point as possible. If measurements are performed in a product specific module jig, then “GND” pads should be used for the probe ground.

Receiver troubleshooting

Introduction to RX troubleshooting

Rx can be tested by making a phone call or in the local mode. For the local mode testing, use Phoenix service software.

The main Rx troubleshooting measurement is RSSI measurement. This test measures the signal strength of the received signal. I and Q branches can be measured separately.

In GSM, the input signal can be either a real GSM signal or a CW signal that is 67.771kHz up from the carrier frequency.

For service tool usage instructions, refer to section Service Tools and Service Concepts.

General instructions for RX troubleshooting

Steps

1. Connect a test jig to a computer with a DKU-2 cable or to a FPS-10 flash prommer with a modular cable (XCS-4).

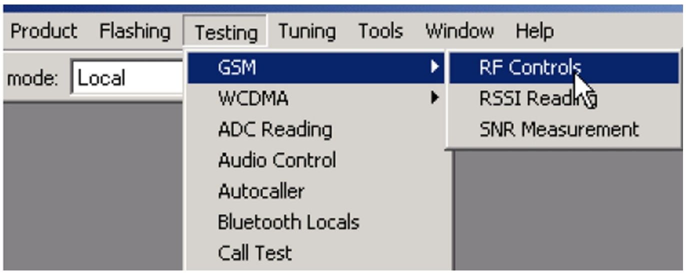
   Make sure that you have a PKD-1 dongle connected to the computer's parallel port.
2. Connect a DC power supply to a module test jig (MJ-69).

Note: Set the DC supply voltage to 12 V and set the jumper connector on the test jig's **reg.pass** switch to "ON" position.

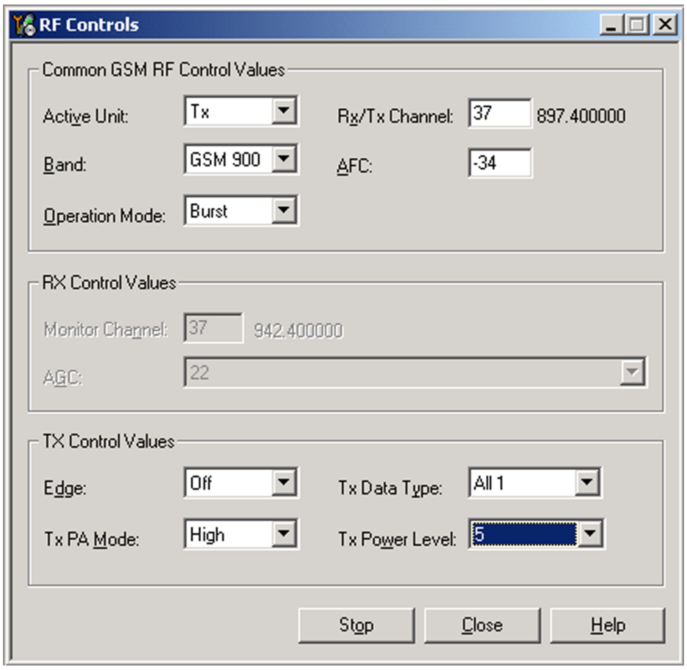
3. Connect an RF cable between the RF connector of the module test jig (MJ-69) and measurement equipment or alternatively use a 50 ohms (at least 2 W) dummy load in the module test jig RF connector, otherwise GSM may be damaged.

   Note: Make sure that all connections are made to the correct RF connector.

4. Set Rx on.
   - i Set the phone module to the test jig and start *Phoenix service software*.
   - ii Initialize connection to the phone. (With FPS-10 use FBUS driver when using DKU-2 and COMBOX driver).
   - iii From the File menu, choose product: **File -> Choose Product -> xx-x*** (* = type designator of the phone, scan product).
   - iv From the toolbar, set operating mode to "Local".
5. EGSM900, GSM850/1800/1900 troubleshooting
   - i From the Testing menu, activate the *RF Controls* window: **Testing -> GSM -> RF Controls** .


Product
Flashing
Testing
Tuning
Tools
Window
Help
mode: Local
GSM
WCDMA
ADC Reading
Audio Control
Autocaller
Bluetooth Locals
Call Test
RF Controls
RSSI Reading
SNR Measurement

   - ii In the *RF Controls* window:
     - Select band "GSM850", "GSM900" or "GSM1800" or "GSM1900" (Default = "GSM850").
     - Set Active unit to "Rx" (Default = "Rx").
     - Set Operation mode to "Burst" (Default = "Burst").
     - Set Rx/Tx channel to 190 on GSM850, 37 on GSM900 band or 700 on GSM1800 band or 661 on GSM1900 (Defaults).
     - Set Edge to "Off" (Default). (Not active in RXmode).
     - Set Tx PA mode to "Free" (Default). (Not active in RXmode).
     - Apply 942.46771 MHz (channel 37 + 67.710 kHz offset), 881.66771MHz (channel 190 + 67.710 kHz), 1842.86771 MHz (channel 700 + 67.710 kHz offset) or 1960.06771 MHz (channel 661 + 67.71 kHz) –90 dBm signal to the RF-connector (remember to compensate for cable attenuation).



Common GSM RF Control Values

Active Unit: Tx

Rx/Tx Channel: 37 897.400000

Band: GSM 900

AFC: -34

Operation Mode: Burst

RX Control Values

Monitor Channel: 37 942.400000

AGC: 22

TX Control Values

Edge: Off

Tx Data Type: All 1

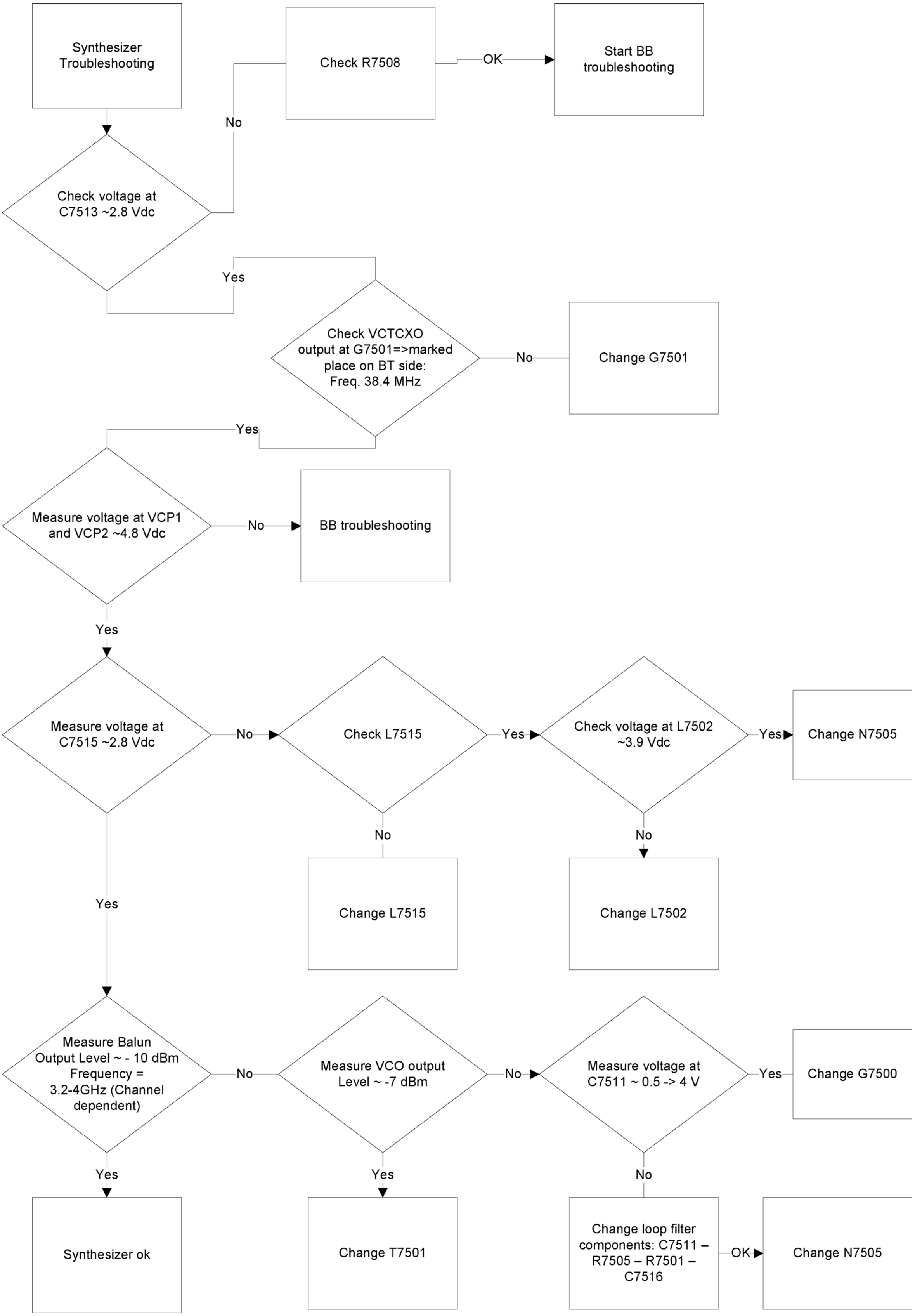
Tx PA Mode: High

Tx Power Level: 5

Figure 47 RF Controls window

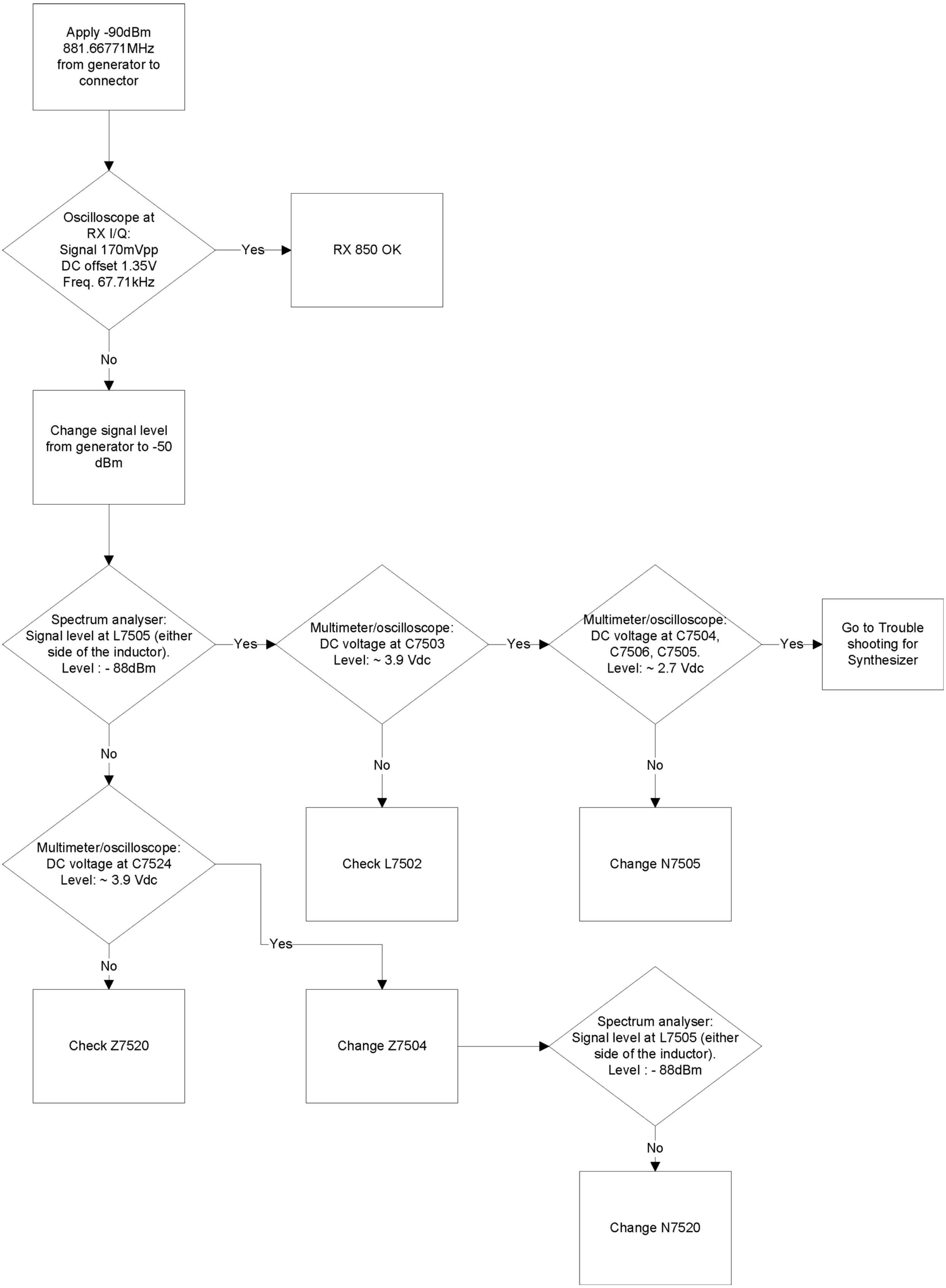
Synthesizer troubleshooting

Troubleshooting flow


Synthesizer Troubleshooting
Check R7508
OK
Start BB troubleshooting
No
Check voltage at C7513 ~2.8 Vdc
Yes
Check VCTCXO output at G7501=>marked place on BT side: Freq. 38.4 MHz
No
Change G7501
Yes
Measure voltage at VCP1 and VCP2 ~4.8 Vdc
No
BB troubleshooting
Yes
Measure voltage at C7515 ~2.8 Vdc
No
Check L7515
Yes
Check voltage at L7502 ~3.9 Vdc
Yes
Change N7505
No
Change L7515
No
Change L7502
Yes
Measure Balun Output Level ~ - 10 dBm Frequency = 3.2-4GHz (Channel dependent)
No
Measure VCO output Level ~ -7 dBm
No
Measure voltage at C7511 ~ 0.5 -> 4 V
Yes
Change G7500
Yes
Synthesizer ok
Yes
Change T7501
No
Change loop filter components: C7511 – R7505 – R7501 – C7516
OK
Change N7505

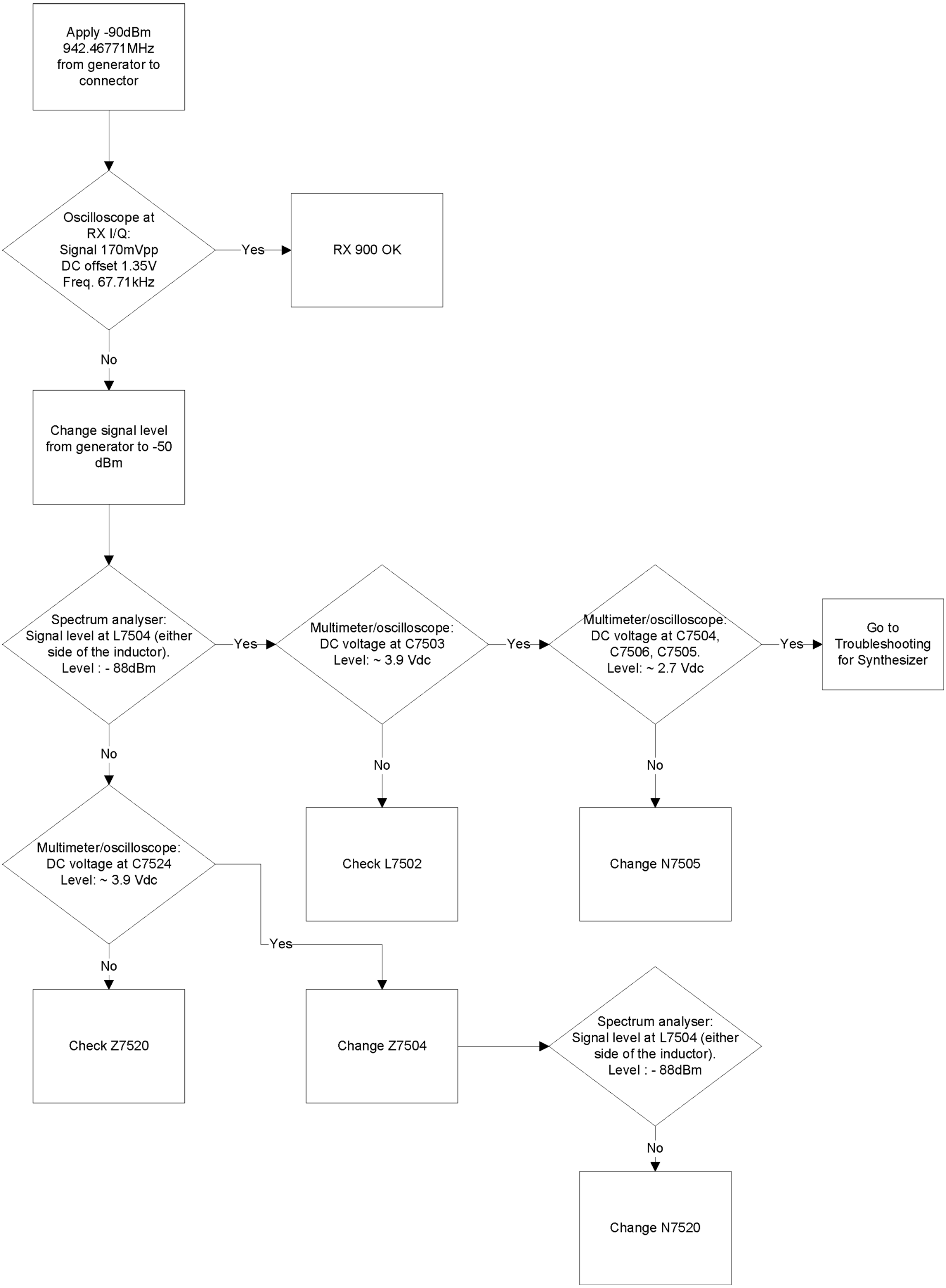
GSM850 RX troubleshooting

Troubleshooting flow


Apply -90dBm 881.66771MHz from generator to connector
Oscilloscope at RX I/Q: Signal 170mVpp DC offset 1.35V Freq. 67.71kHz
Yes
RX 850 OK
No
Change signal level from generator to -50 dBm
Spectrum analyser: Signal level at L7505 (either side of the inductor). Level : - 88dBm
Yes
Multimeter/oscilloscope: DC voltage at C7503 Level: ~ 3.9 Vdc
Yes
Multimeter/oscilloscope: DC voltage at C7504, C7506, C7505. Level: ~ 2.7 Vdc
Yes
Go to Trouble shooting for Synthesizer
No
No
No
Multimeter/oscilloscope: DC voltage at C7524 Level: ~ 3.9 Vdc
Check L7502
Change N7505
Yes
No
Check Z7520
Change Z7504
Spectrum analyser: Signal level at L7505 (either side of the inductor). Level : - 88dBm
No
Change N7520

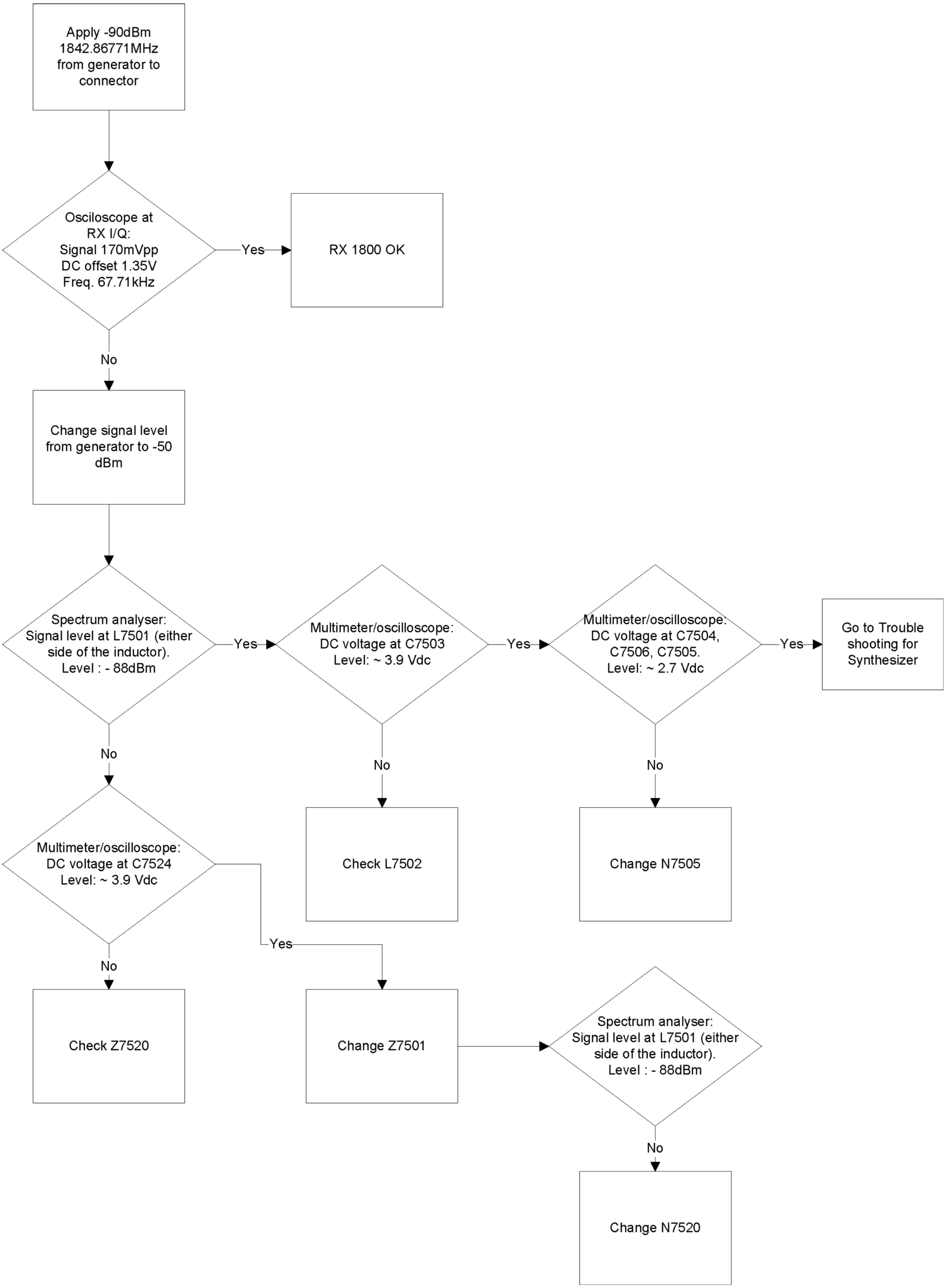
GSM900 RX troubleshooting

Troubleshooting flow


Apply -90dBm 942.46771MHz from generator to connector
Oscilloscope at RX I/Q: Signal 170mVpp DC offset 1.35V Freq. 67.71kHz
Yes
RX 900 OK
No
Change signal level from generator to -50 dBm
Spectrum analyser: Signal level at L7504 (either side of the inductor). Level : - 88dBm
Yes
Multimeter/oscilloscope: DC voltage at C7503 Level: ~ 3.9 Vdc
Yes
Multimeter/oscilloscope: DC voltage at C7504, C7506, C7505. Level: ~ 2.7 Vdc
Yes
Go to Troubleshooting for Synthesizer
No
No
No
Multimeter/oscilloscope: DC voltage at C7524 Level: ~ 3.9 Vdc
Check L7502
Change N7505
Yes
No
Check Z7520
Change Z7504
Spectrum analyser: Signal level at L7504 (either side of the inductor). Level : - 88dBm
No
Change N7520

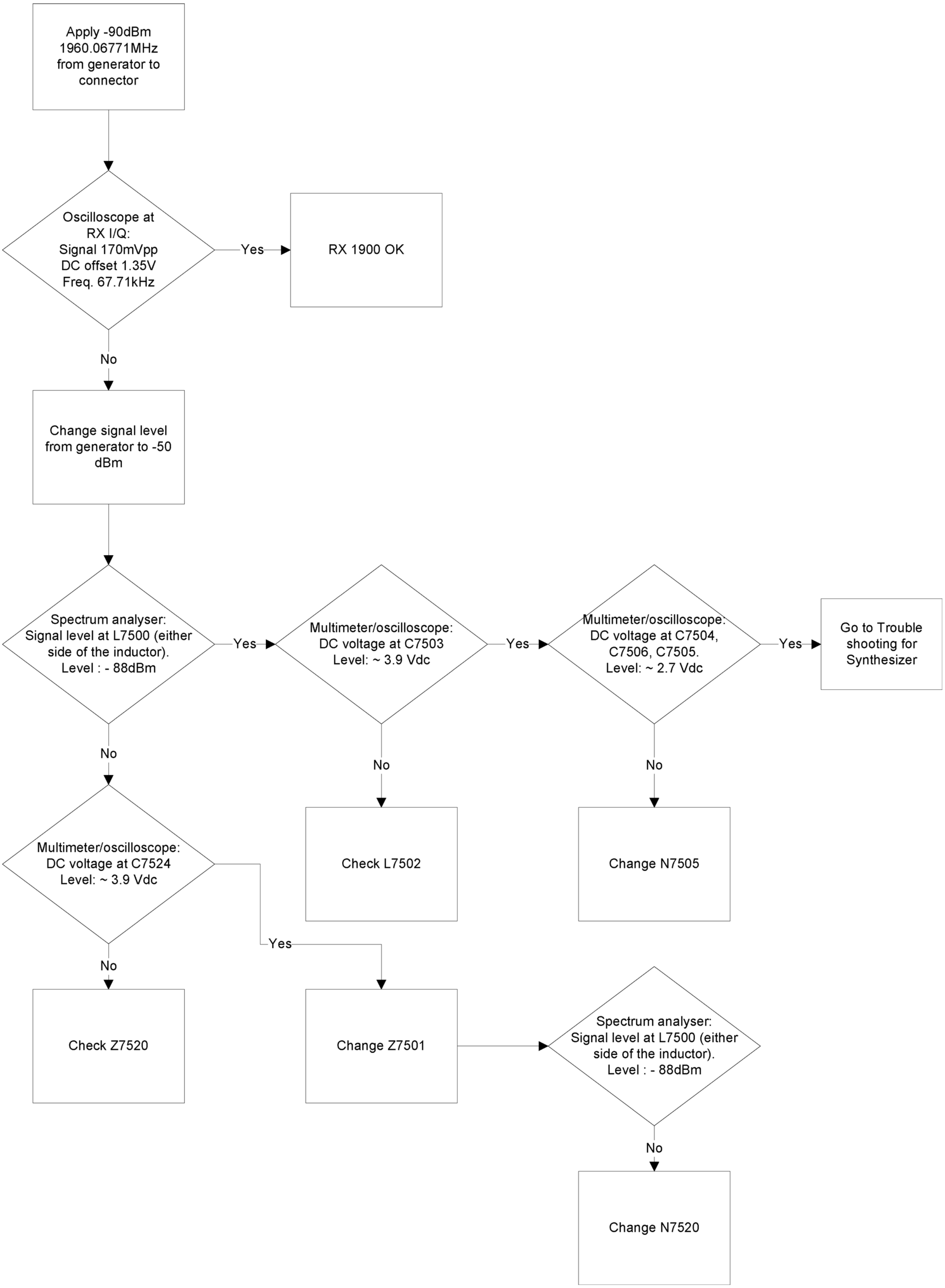
GSM1800 RX troubleshooting

Troubleshooting flow


Apply -90dBm 1842.86771MHz from generator to connector
Osciloscope at RX I/Q: Signal 170mVpp DC offset 1.35V Freq. 67.71kHz
Yes
RX 1800 OK
No
Change signal level from generator to -50 dBm
Spectrum analyser: Signal level at L7501 (either side of the inductor). Level : - 88dBm
Yes
Multimeter/oscilloscope: DC voltage at C7503 Level: ~ 3.9 Vdc
Yes
Multimeter/oscilloscope: DC voltage at C7504, C7506, C7505. Level: ~ 2.7 Vdc
Yes
Go to Trouble shooting for Synthesizer
No
No
No
Multimeter/oscilloscope: DC voltage at C7524 Level: ~ 3.9 Vdc
Check L7502
Change N7505
Yes
No
Check Z7520
Change Z7501
Spectrum analyser: Signal level at L7501 (either side of the inductor). Level : - 88dBm
No
Change N7520

GSM1900 RX troubleshooting

Troubleshooting flow


Apply -90dBm 1960.06771MHz from generator to connector
Oscilloscope at RX I/Q: Signal 170mVpp DC offset 1.35V Freq. 67.71kHz
Yes
RX 1900 OK
No
Change signal level from generator to -50 dBm
Spectrum analyser: Signal level at L7500 (either side of the inductor). Level : - 88dBm
Yes
Multimeter/oscilloscope: DC voltage at C7503 Level: ~ 3.9 Vdc
Yes
Multimeter/oscilloscope: DC voltage at C7504, C7506, C7505. Level: ~ 2.7 Vdc
Yes
Go to Trouble shooting for Synthesizer
No
No
No
Multimeter/oscilloscope: DC voltage at C7524 Level: ~ 3.9 Vdc
Check L7502
Change N7505
Yes
No
Check Z7520
Change Z7501
Spectrum analyser: Signal level at L7500 (either side of the inductor). Level : - 88dBm
No
Change N7520

GSM Rx chain activation for manual measurements / GSM RSSI measurement

Context

RSSI signal measurement is the main Rx troubleshooting measurement. The test measures the strength of the received signal.

I and Q branches can be measured separately. In GSM, the input signal can be either real GSM signal or a CW (Continuous Wave) signal that is 67.771 kHz above the carrier frequency.

Steps

1. Start *Phoenix* service software.
2. Choose **Testing→GSM→RSSI Reading** .
3. Set the RF signal generator for channel frequency +67.771 kHz CW mode with −80 dBm signal.

   Alternatively set the cellular tester downlink channel to the appropriate channel. Make sure that the tester is set to continuous mode, not to burst mode.
4. In the *RSSI Reading* window, select the appropriate band and channel.

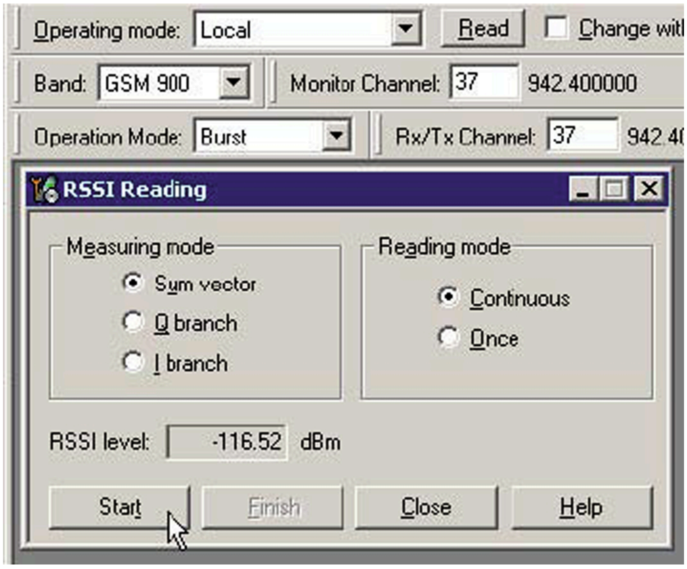

Operating mode: Local
☐ Change wit
Band: GSM 900
Monitor Channel: 37 942.400000
Operation Mode: Burst
Rx/Tx Channel: 37 942.4
Measuring mode: ● Sum vector ○ Q branch ○ I branch
Reading mode: ● Continuous ○ Once
RSSI level: -116.52 dBm

Figure 48 ***RSSI Reading*** **window**

5. To start the measurement, activate GSM Rx chain, click **Start**.

Results

RSSI reading values of the selected band and channel are displayed. The RSSI level must be the same value which is set at the signal generator (-80 dBm).

■ Transmitter troubleshooting

General instructions for TX troubleshooting

Context

- Tx troubleshooting requires Tx operation.
- Do not transmit on frequencies that are in use!
- Transmitter can be controlled in the local mode for diagnostic purposes.
- The most useful Phoenix tool for GSM transmitter testing is "RF Controls".

- Tx IQ tuning and Tx power tuning can be also used in some cases.
- Remember that retuning is not a fix! Phones are tuned correctly in production.

The first set of steps instructs how to assemble the test setup. This setup is general for all Tx troubleshooting tasks.

Alternative steps provide specific troubleshooting instructions for *Phoenix* service software.

> **Caution:** Never activate the GSM transmitter without a proper antenna load. There should be always 50 ohm load connected to the RF connector (antenna, RF-measurement equipment or at least 2 watts dummy load), otherwise GSM PA may be damaged.

Steps

1. Connect a test jig to a computer with a DKU-2 cable or to a FPS-10 flash prommer with a modular cable (XCS-4).

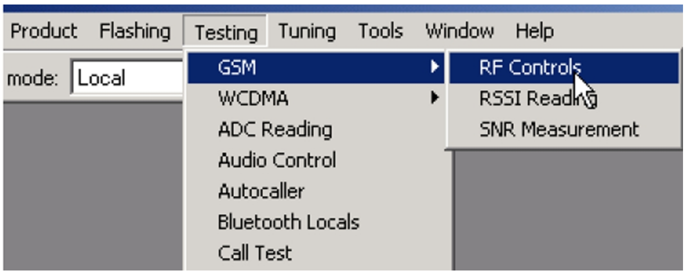
   Make sure that you have a PKD-1 dongle connected to the computer's parallel port.
2. Connect a DC power supply to a module jig (MJ-69).

   > **Note:** When repairing or tuning a transmitter, use an external DC supply with at least 3 A current capability.
   >
   > Set the DC supply voltage to 12V and set the jumper connector on the test jig's **reg.pass** switch to “ON” position.
3. Connect an RF cable between the RF connector of the module test jig (MJ-69) and measurement equipment or alternatively use a 50 ohms (at least 2 W) dummy load in the module test jig RF connector, otherwise GSM may be damaged.

   > **Note:** There are two antenna connectors in the module jig:
   >
   > - one for GSM
   > - one for Bluetooth
   >
   > Make sure that all connections are made to the correct RF connector.

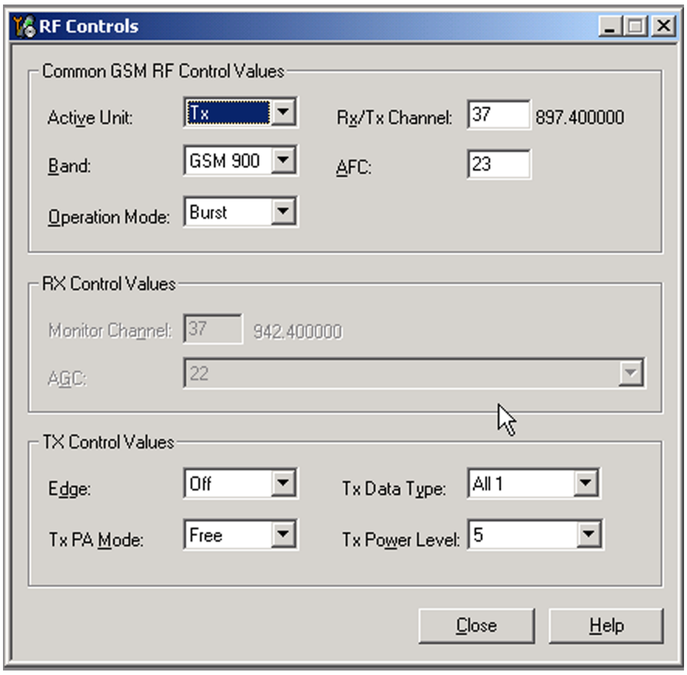
   Normally a spectrum analyser is used as measurement equipment.

   > **Note:** The maximum input power of a spectrum analyser is +30 dBm.
   >
   > To prevent any damage, it is recommended to use 10 dB attenuator on the spectrum analyzer input.
4. Set Tx on.
   - i Set the phone module to the test jig and start *Phoenix service software*.
   - ii Initialize connection to the phone. (With FPS-10 use FBUS driver when using DAU-9S and COMBOX driver).
   - iii From the File menu, choose product: **File -> Choose Product -> xx-x*** (* = type designator of the phone).
   - iv From the toolbar, set operating mode to “Local”.
5. EGSM900, GSM850/1800/1900 troubleshooting
   - i From the Testing menu, activate the *RF Controls* window: **Testing -> GSM -> RF Controls** .


Product
Flashing
Testing
Tuning
Tools
Window
Help
mode:
Local
GSM
WCDMA
ADC Reading
Audio Control
Autocaller
Bluetooth Locals
Call Test
RF Controls
RSSI Reading
SNR Measurement

ii In the *RF Controls* window:

- Select band "GSM850", "GSM900" or "GSM1800" or "GSM1900" (Default = "GSM850").
- Set Active unit to "Tx" (Default = "Rx").
- Set Operation mode to "Burst" (Default = "Burst").
- Set Tx data type to "Random" (Default = "All1").
- Set Rx/Tx channel to 190 on GSM850, 37 on GSM900 band or 700 on GSM1800 band or 661 on GSM1900 (Defaults).
- Set Edge to "Off" (Default).
- Set Tx PA mode to "Free" (Default).
- Set power level to 5 (Default = 19) on GSM850/900 or to 0 (Default = 15) on GSM1800 or GSM1900.


RF Controls

Common GSM RF Control Values
Active Unit: Tx
Rx/Tx Channel: 37 897.400000
Band: GSM 900
AFC: 23
Operation Mode: Burst

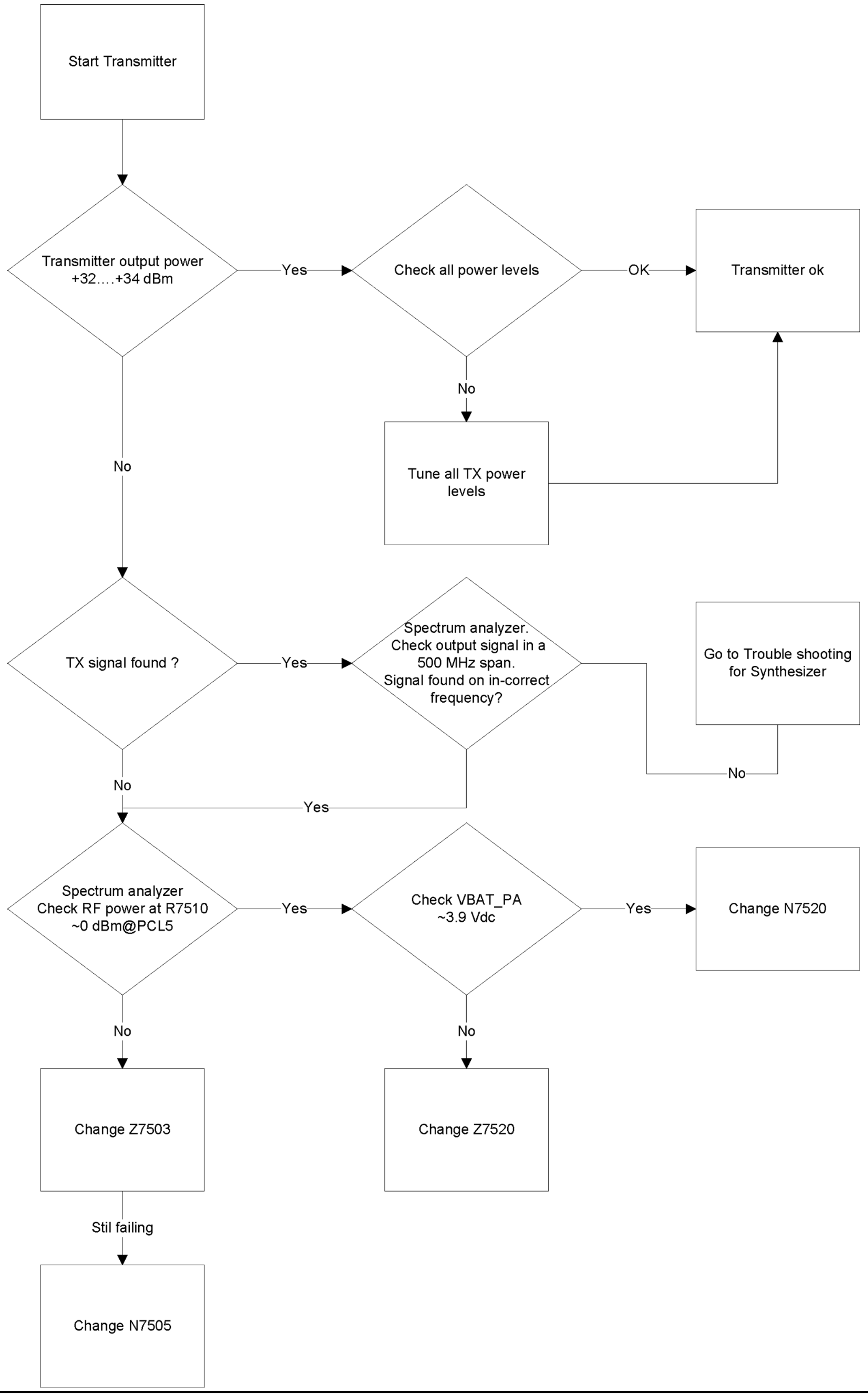
RX Control Values
Monitor Channel: 37 942.400000
AGC: 22

TX Control Values
Edge: Off
Tx Data Type: All 1
Tx PA Mode: Free
Tx Power Level: 5

Figure 49 RF Controls window

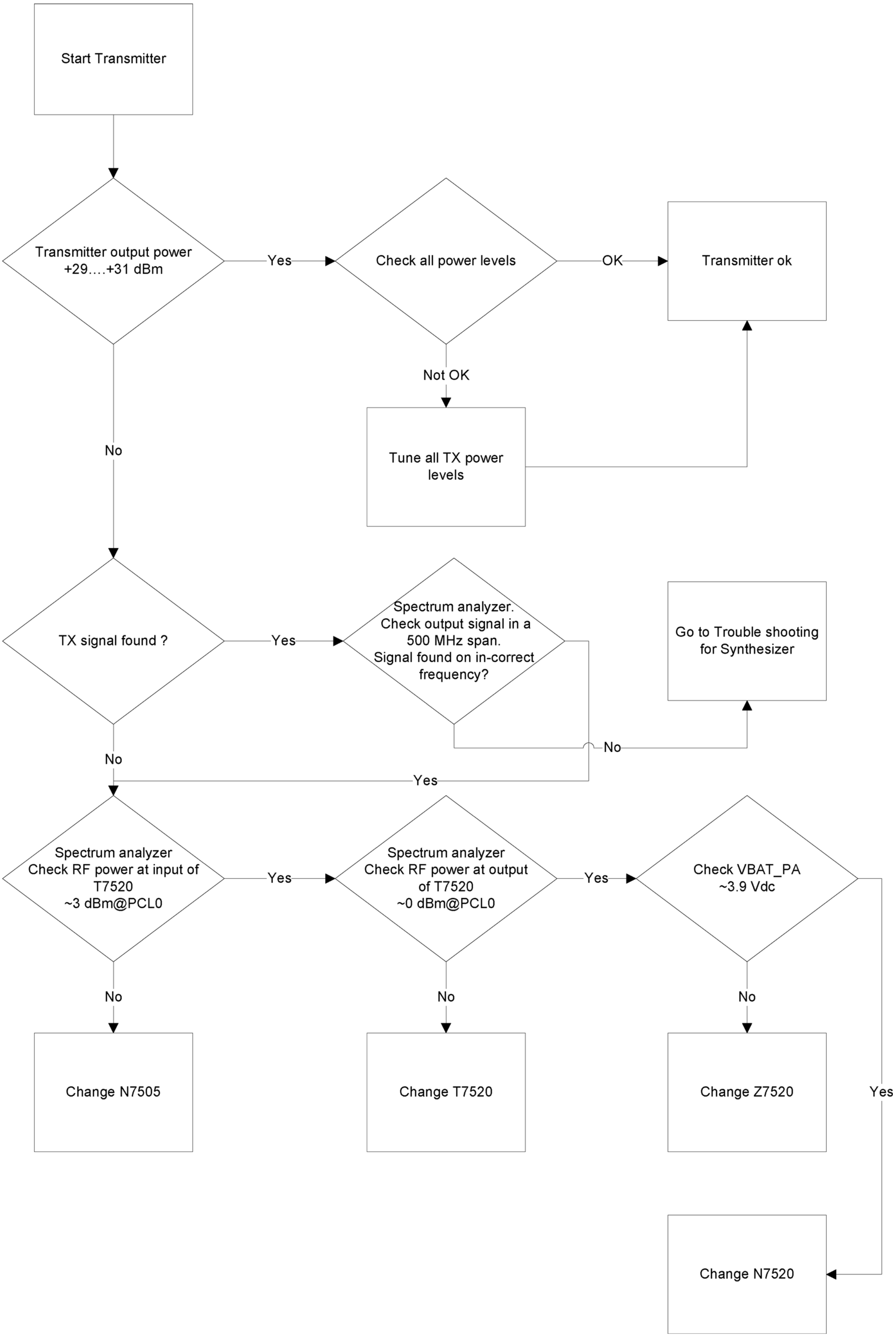
GSM850/900 TX troubleshooting

Troubleshooting flow


Start Transmitter
Transmitter output power +32….+34 dBm
Yes
Check all power levels
OK
Transmitter ok
No
Tune all TX power levels
No
TX signal found ?
Yes
Spectrum analyzer. Check output signal in a 500 MHz span. Signal found on in-correct frequency?
Go to Trouble shooting for Synthesizer
No
No
Yes
Spectrum analyzer Check RF power at R7510 ~0 dBm@PCL5
Yes
Check VBAT_PA ~3.9 Vdc
Yes
Change N7520
No
No
Change Z7503
Change Z7520
Stil failing
Change N7505

GSM1800/1900 TX troubleshooting

Troubleshooting flow


Start Transmitter
Transmitter output power +29….+31 dBm
Yes
Check all power levels
OK
Transmitter ok
Not OK
Tune all TX power levels
No
TX signal found ?
Yes
Spectrum analyzer. Check output signal in a 500 MHz span. Signal found on in-correct frequency?
Go to Trouble shooting for Synthesizer
No
No
Yes
Spectrum analyzer Check RF power at input of T7520 ~3 dBm@PCL0
Yes
Spectrum analyzer Check RF power at output of T7520 ~0 dBm@PCL0
Yes
Check VBAT_PA ~3.9 Vdc
No
No
No
Change N7505
Change T7520
Change Z7520
Yes
Change N7520

Checking antenna functionality

The main antenna has one antenna: GSM.

In the GSM antenna, there is one Feed and two GND contacts.

The contacts of the GSM antenna are separated in the (RDC = 0 ohm) short-circuit.

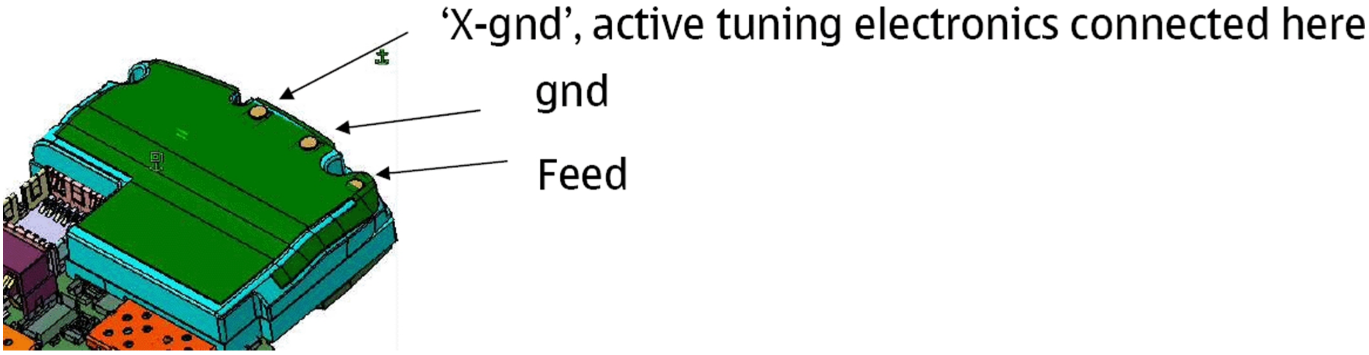


Figure 50 Main antenna

The antenna is functioning normally when the contacts function (RDC = 0 ohm) and the antenna is visually intact.

BT antenna

BT antenna is a conventional PWB antenna. BT antenna can be damaged only by ripping the antenna feeding capacitor off.

RF tunings

Introduction to RF tunings

Important: Only perform RF tunings if:

- one or more of the RF components is changed
- flash Memory chip is changed or otherwise corrupted.

RF calibration is always performed with the help of a product-specific module jig, never with an RF coupler. Using an RF coupler in the calibration phase will cause a complete mistuning of the RF side.

Important: After RF component changes, **always** use autotuning. Manual tunings are only required in rare cases.

Cable and adapter losses

RF cables and adapters have some losses. They have to be taken in account when the phone is tuned. As all the RF losses are frequency dependent, the user have to be very careful and understand the measurement setup. In the following table there are RF attenuations of the module jig:

Band	Attenuation
GSM850	0.2 dB
GSM900	0.2 dB
GSM1800	0.3 dB
GSM1900	0.3 dB

RF autotuning

Prerequisites

For information on the recommended test set-up, refer to the corresponding information on PWS/NOL.

Before you can use the auto-tune feature, the GPIB driver from the GPIB card vendor must be installed and running.

The autotune **.ini** file must be in a correct place: **C:\Program Files\Nokia\Phoenix\products\xx-x*\autotune_xx-x*.ini** (**= indicates the type designator of the phone, e.g. RM-1*)

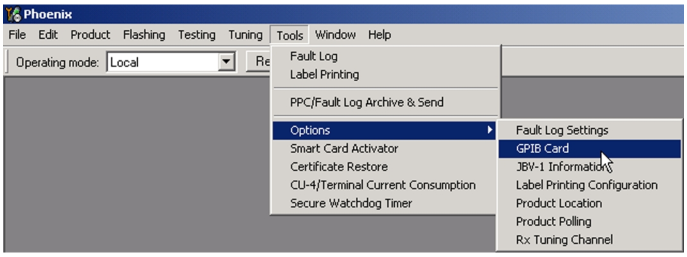
Context

RF autotuning is performed with the aid of Digital Radio Communication Tester. Autotuning covers all RF tunings that are needed to perform after RF component repairs.

> **Note:** Do not perform RF autotuning without a proper reason. Phones are tuned in production and an RF tuning may be performed only after component repairs or if the RF tuning information is lost.

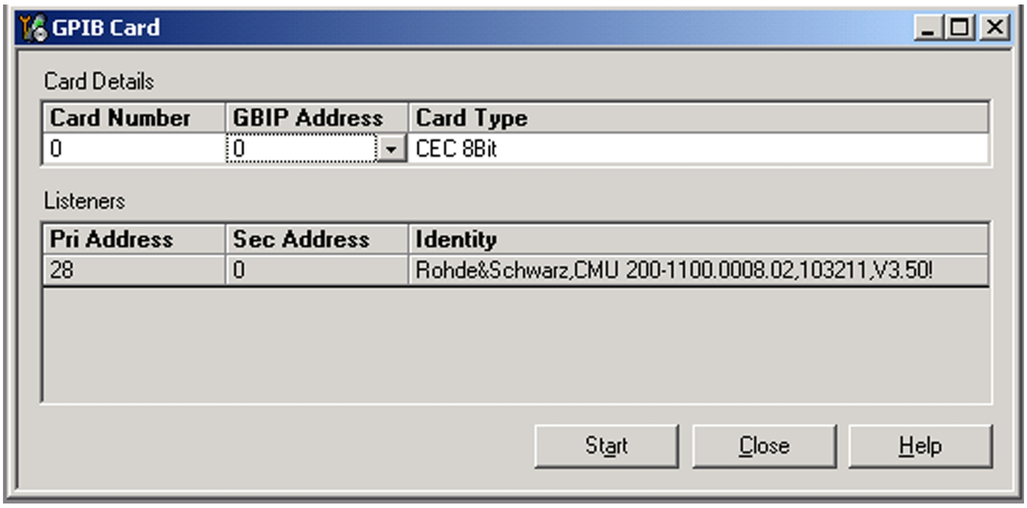
Steps

1. Connect the communication tester to the GPIB bus.
2. Start Phoenix service software.
3. From the Tools menu, choose Options -> GPIB Card.


Phoenix
File
Edit
Product
Flashing
Testing
Tuning
Tools
Window
Help
Operating mode: Local
Re
Fault Log
Label Printing
PPC/Fault Log Archive & Send
Options
Smart Card Activator
Certificate Restore
CU-4/Terminal Current Consumption
Secure Watchdog Timer
Fault Log Settings
GPIB Card
JBV-1 Information
Label Printing Configuration
Product Location
Product Polling
Rx Tuning Channel

4. In the Card Type line, select CEC8Bit, then click Start.

   After clicking Start, the name of the communication tester appears in the list of found Listeners.


GPIB Card
Start
Close
Help

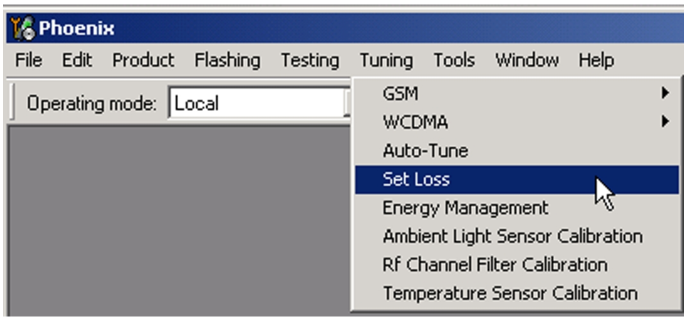
Card Details

Card Number	GBIP Address	Card Type
0	0	CEC 8Bit

Listeners

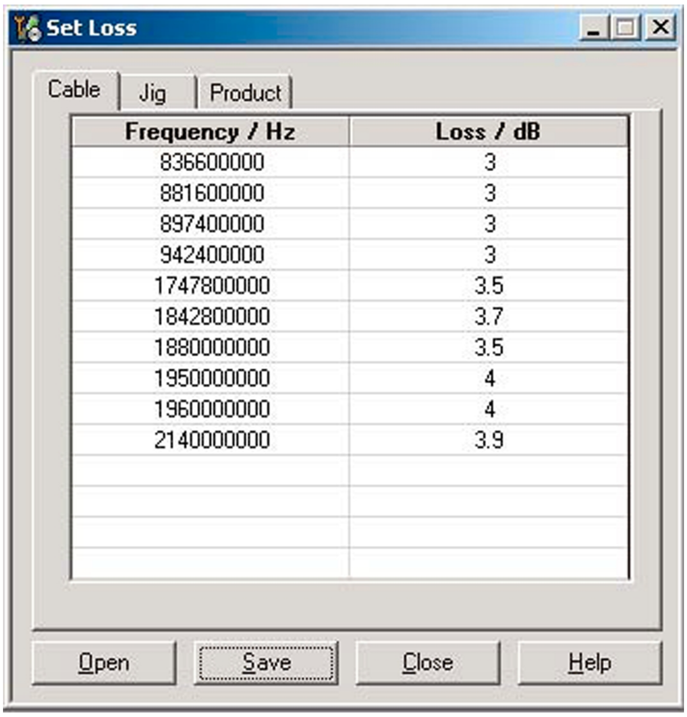
Pri Address	Sec Address	Identity
28	0	Rohde&Schwarz,CMU 200-1100.0008.02,103211,V3.50!

5. To specify the cable loss from module jig to the communication tester, choose "Set Loss" from the Tuning menu.


Phoenix
File Edit Product Flashing Testing Tuning Tools Window Help
Operating mode: Local
GSM
WCDMA
Auto-Tune
Set Loss
Energy Management
Ambient Light Sensor Calibration
Rf Channel Filter Calibration
Temperature Sensor Calibration

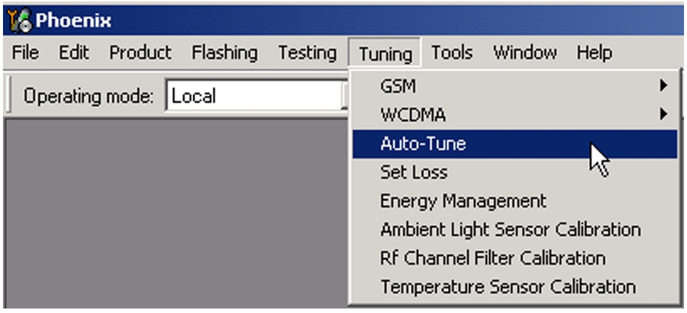
6. Click the Cable tab and add the extra cable attenuation.

Note: Cable losses have to be determined on the basis of a cable used.


Set Loss
Cable
Jig
Product
Open
Save
Close
Help

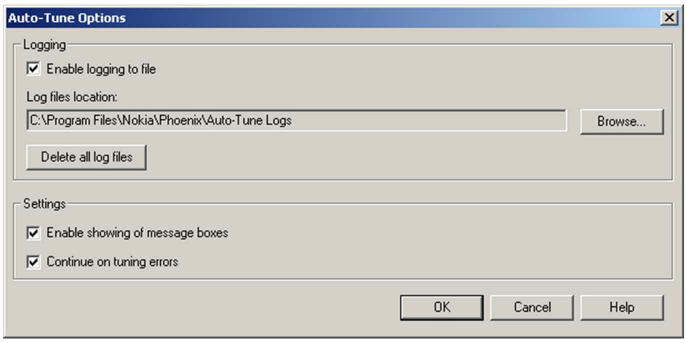
Frequency / Hz	Loss / dB
836600000	3
881600000	3
897400000	3
942400000	3
1747800000	3.5
1842800000	3.7
1880000000	3.5
1950000000	4
1960000000	4
2140000000	3.9

7. To start autotuning, choose Auto-Tune from the Tuning menu.


Phoenix
File Edit Product Flashing Testing Tuning Tools Window Help
Operating mode: Local
GSM
WCDMA
Auto-Tune
Set Loss
Energy Management
Ambient Light Sensor Calibration
Rf Channel Filter Calibration
Temperature Sensor Calibration

8. In the Auto-Tune window, click Options.

9. In the Auto-Tune options window, see that the "Enable showing of messages" check box is checked, then click OK.


Auto-Tune Options

Logging

☑ Enable logging to file

Log files location: C:\Program Files\Nokia\Phoenix\Auto-Tune Logs

Settings

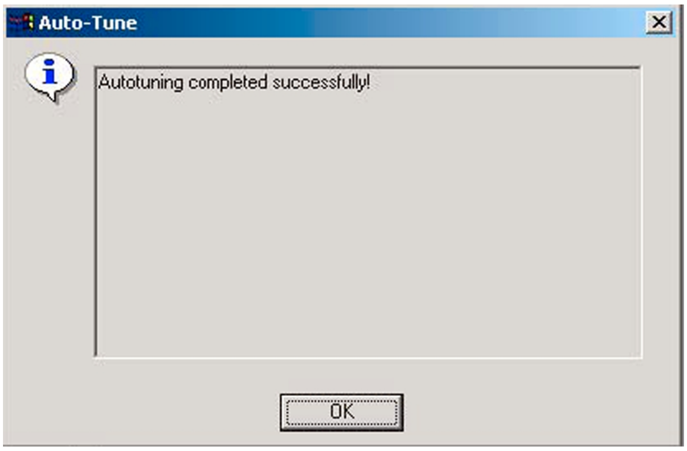
☑ Enable showing of message boxes

☑ Continue on tuning errors

10. To complete the RF autotuning, click OK.

Results

"Autotuning completed successfully" message appears.


Auto-Tune

Autotuning completed successfully!

System mode independent manual tunings

Rf channel filter calibration

Context

Rf channel filter calibration tunes the internal low pass filters of Rx and Tx ASICs that limit the bandwidth of BB IQ signals.

One common calibration is made for GSM.

Table 10 Rf channel filter calibration tuning limits

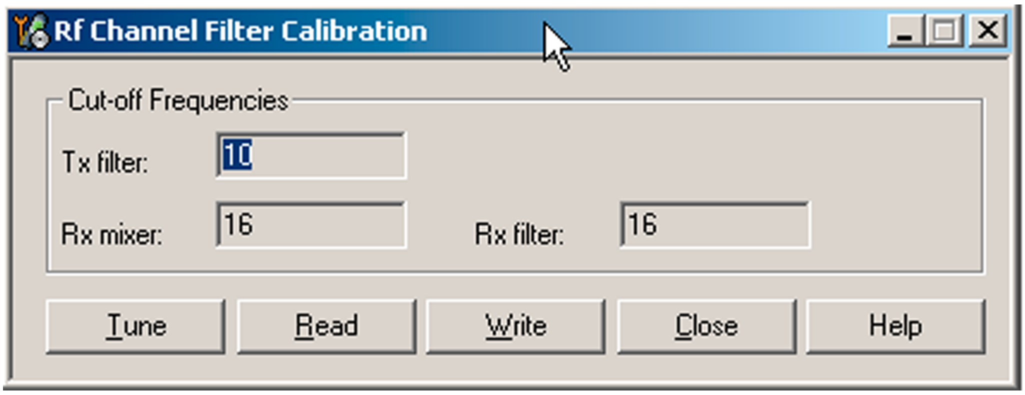
	Min	Typ	Max
Tx filter	0	10	31
Rx filter	0	16	31

Steps

1. From the **Operating mode** drop-down menu, set mode to **Local**.
2. Choose **Tuning→Rf Channel Filter Calibration** .

3. Click **Tune**.
4. To save the values to the PMM (Phone Permanent Memory) area, click **Write**.
5. To close the *Rf Channel Filter Calibration* window, click **Close**.

Results



Tx filter: 10

Rx mixer: 16

Rx filter: 16

Figure 51 Rf channel filter calibration typical values

PA (power amplifier) detection

Context

The PA detection procedure detects which PA manufacturer is used for phone PAs.

If a PA is changed or if the permanent memory (PMM) data is corrupted, PA detection has to be performed before Tx tunings.

Steps

1. From the **Operating mode** drop-down menu, set mode to **Local**.
2. Choose **Tuning→PA Detection** .
3. Click **Tune**.
4. Check that the detected PA manufacturers are corresponding to the actual chips on the board.
5. To end the procedure, click **Close**.

GSM receiver tunings

Rx calibration (GSM)

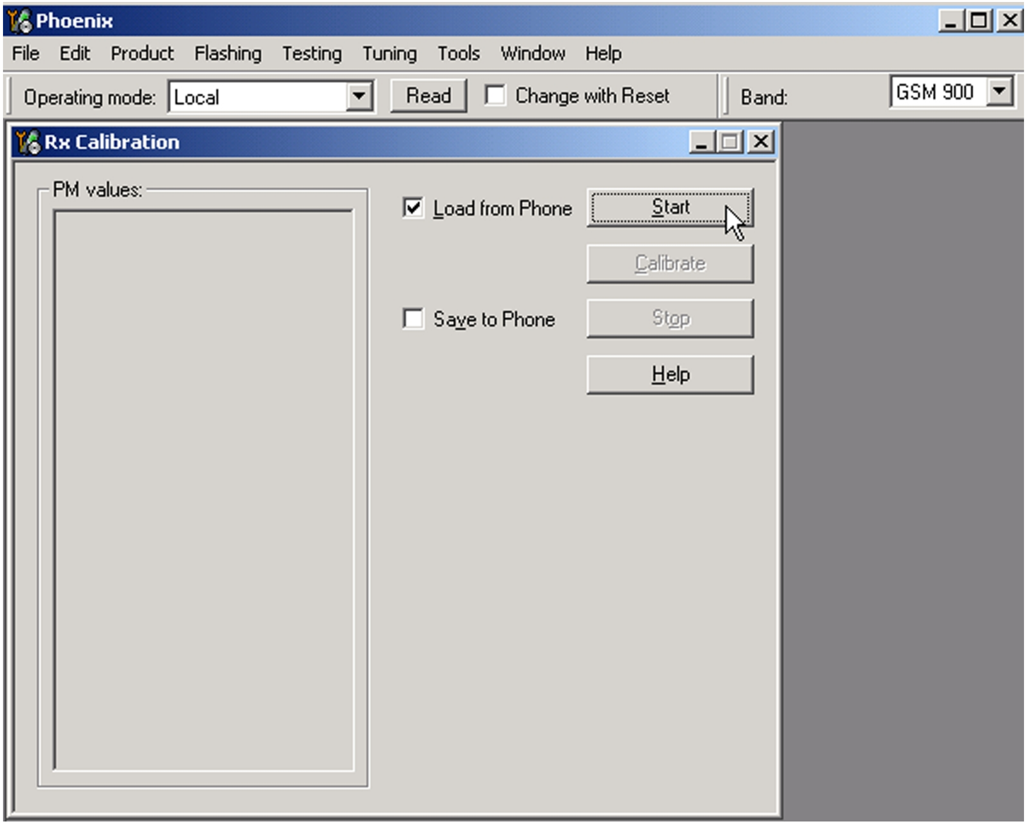
Context

Rx Calibration is used to find out the real gain values of the GSM Rx AGC system and tuning response of the AFC system (AFC D/A init value and AFC slope)

Steps

1. Connect the GSM connector of the module jig to a signal generator.
2. Start *Phoenix* service software.
3. From the **Operating mode** drop-down menu, set mode to **Local**.
4. Choose **Tuning→GSM→Rx Calibration** .
5. Check the **Load from Phone** check box, and uncheck **Save to Phone**.
6. From the **Band** drop-down menu, choose e.g. **GSM900**.

7. Click **Start**.


Phoenix
File Edit Product Flashing Testing Tuning Tools Window Help
Read
Band:
Rx Calibration
PM values:
Start
Calibrate
Stop
Help

Operating mode: Local

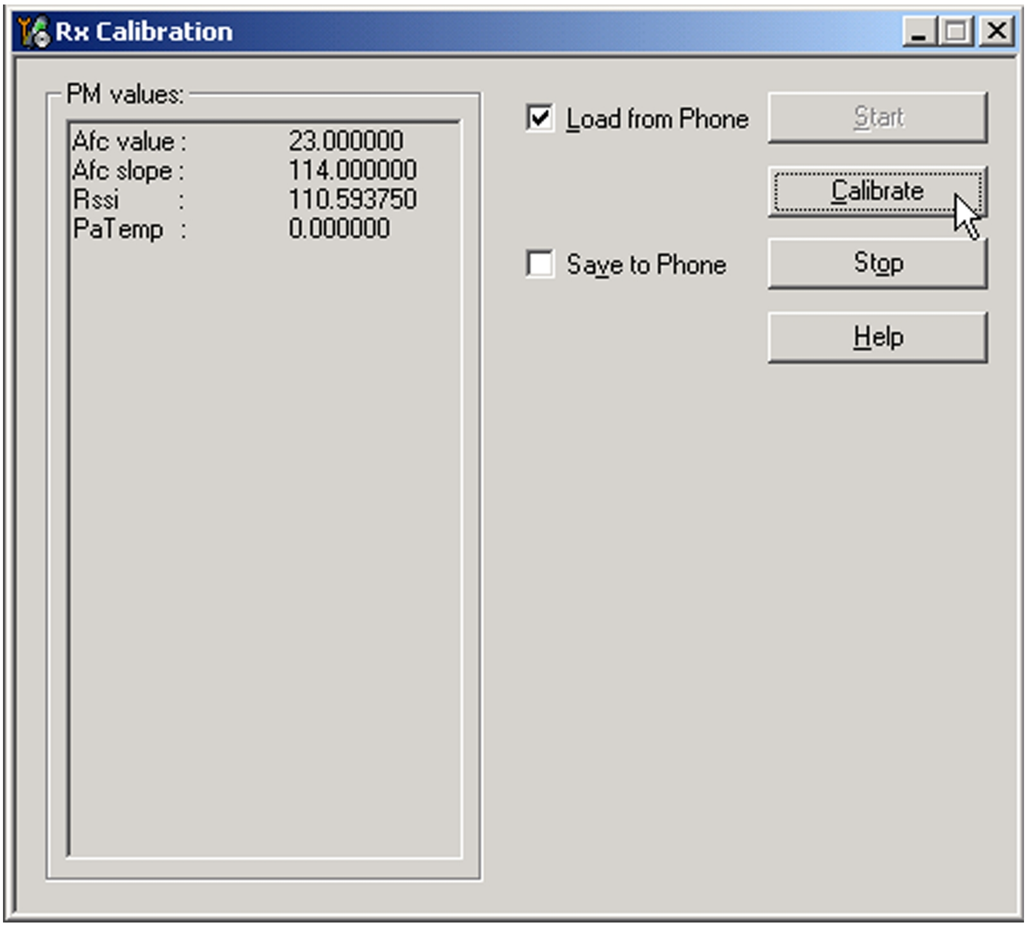
☐ Change with Reset

Band: GSM 900

☑ Load from Phone

☐ Save to Phone

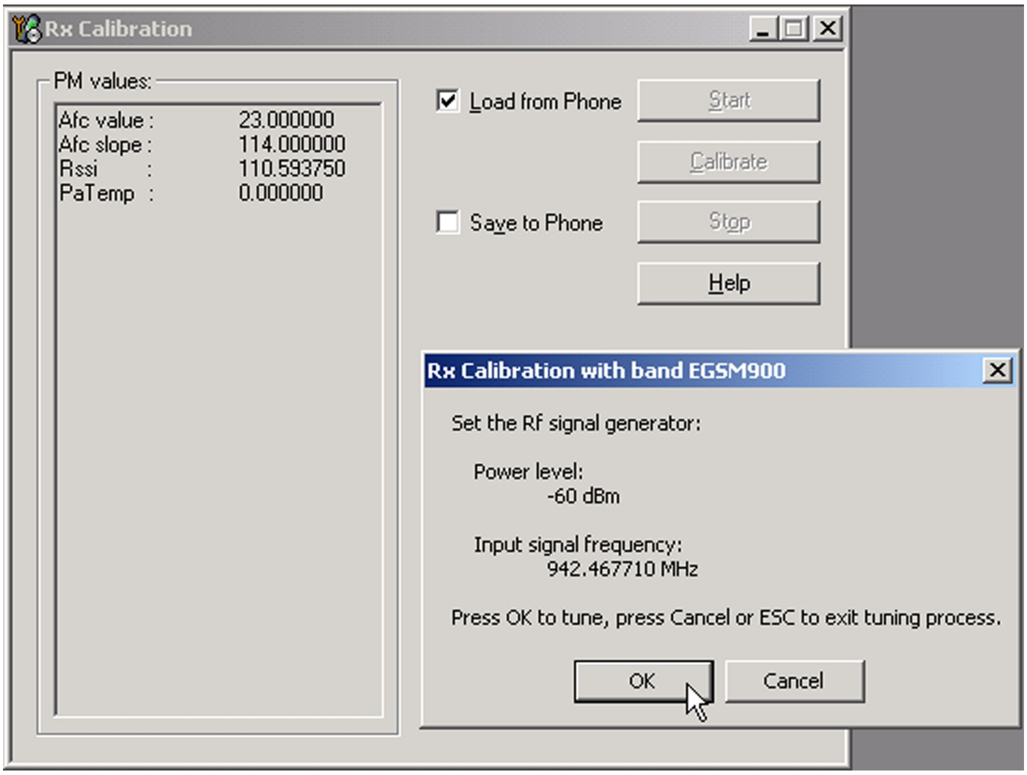
8. Click **Calibrate**.


Rx Calibration
PM values:
☑ Load from Phone
Start
Calibrate
☐ Save to Phone
Stop
Help

Afc value : 23.000000
Afc slope : 114.000000
Rssi : 110.593750
PaTemp : 0.000000

9. Connect the signal generator to the phone, and set frequency and amplitude as instructed in the **Rx Calibration with band EGSM900** pop-up window.

 Important: The calibration uses a non-modulated CW signal. Increase the signal generator level by cable attenuation and module jig probe attenuation.



Afc value : 23.000000
Afc slope : 114.000000
Rssi : 110.593750
PaTemp : 0.000000

☑ Load from Phone
☐ Save to Phone

Rx Calibration with band EGSM900

Set the Rf signal generator:

Power level:
-60 dBm

Input signal frequency:
942.467710 MHz

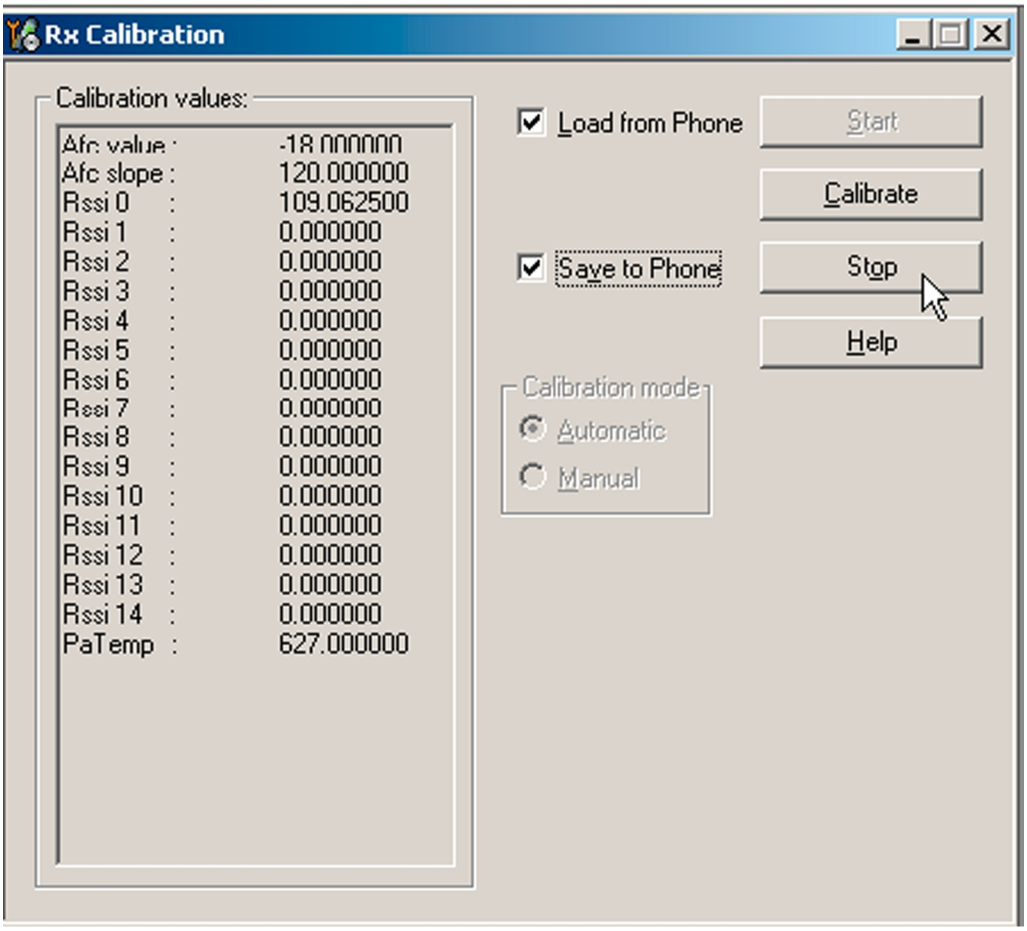
Press OK to tune, press Cancel or ESC to exit tuning process.

10. To perform the tuning, click **OK**.
11. Check that the tuning values are within the limits specified in the following table:

Table 11 RF tuning limits in Rx calibration

	Min	Typ	Max	Unit
GSM850				
AFC Value	-200	-105...62	200	
AFC slope	0	122	200	
RSSI0	106	107...110	114	dB
GSM900				
AFC Value	-200	-105...62	200	
AFC slope	0	122	200	
RSSI0	106	107...110	114	dB
GSM1800				
RSSI0	104	104...109	114	dB
GSM1900				
RSSI0	104	104...109	114	dB

12. To save values to the phone, check the **Save to Phone** check box, and click **Stop**.



Calibration values:

```
Afc value :     -18.000000
Afc slope :     120.000000
Rssi 0    :     109.062500
Rssi 1    :     0.000000
Rssi 2    :     0.000000
Rssi 3    :     0.000000
Rssi 4    :     0.000000
Rssi 5    :     0.000000
Rssi 6    :     0.000000
Rssi 7    :     0.000000
Rssi 8    :     0.000000
Rssi 9    :     0.000000
Rssi 10   :     0.000000
Rssi 11   :     0.000000
Rssi 12   :     0.000000
Rssi 13   :     0.000000
Rssi 14   :     0.000000
PaTemp    :     627.000000
```

☑ Load from Phone

☑ Save to Phone

Calibration mode
- ● Automatic
- ○ Manual

Next actions

Repeat steps 3 to 8 for GSM850, GSM1800 and GSM1900

Rx band filter response compensation (GSM)

Prerequisites

Rx calibration must be done before the Rx Band Filter Response Compensation

Context

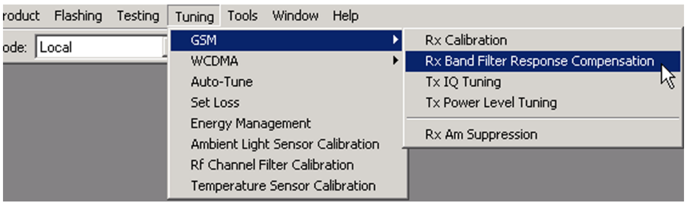
In each GSM Rx band, there's a band rejecting filter in front of RF ASIC front end. The amplitude ripple caused by these filters causes ripple to the RSSI measurement and therefore calibration is needed.

The calibration has to be repeated for each GSM band.

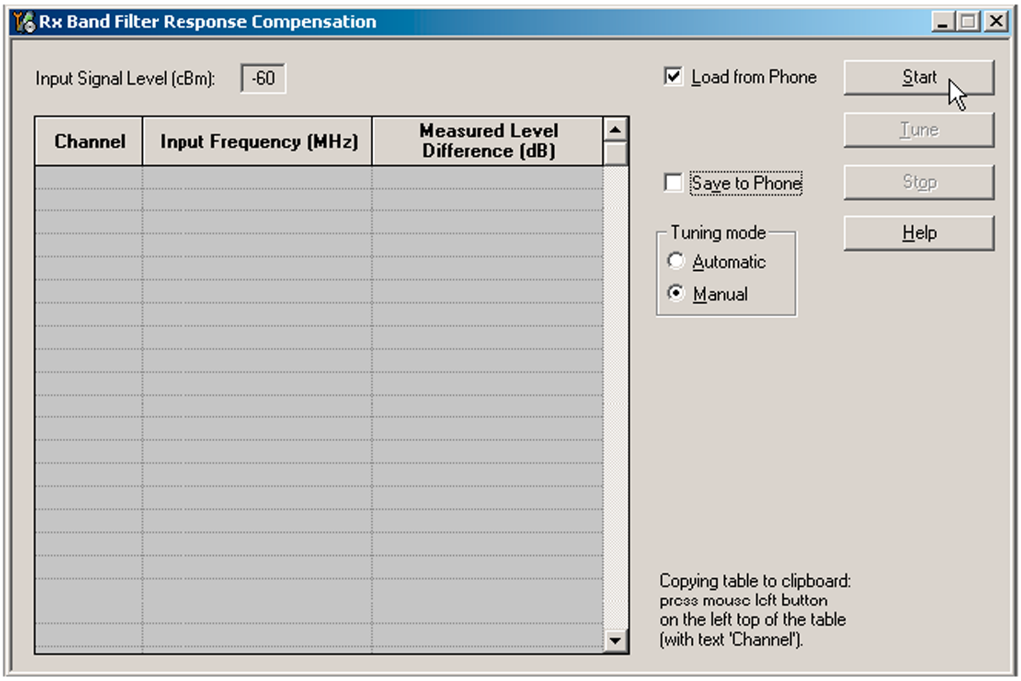
Steps

1. Connect module jig's GSM connector to signal generator.
2. From the dropdown menus, set "Operating mode" to Local, "System mode" to GSM, and Band to GSM900.

3. From the Tuning menu, choose GSM -> Rx Band Filter Response Compensation.


roduct
Flashing
Testing
Tuning
Tools
Window
Help
ode: Local
GSM
WCDMA
Auto-Tune
Set Loss
Energy Management
Ambient Light Sensor Calibration
Rf Channel Filter Calibration
Temperature Sensor Calibration
Rx Calibration
Rx Band Filter Response Compensation
Tx IQ Tuning
Tx Power Level Tuning
Rx Am Suppression

4. Check “Manual” and “Load from Phone” check boxes. Clear “Save to Phone” check box
5. Click Start.


Rx Band Filter Response Compensation
Start
Tune
Stop
Help

Input Signal Level (cBm): -60

☑ Load from Phone

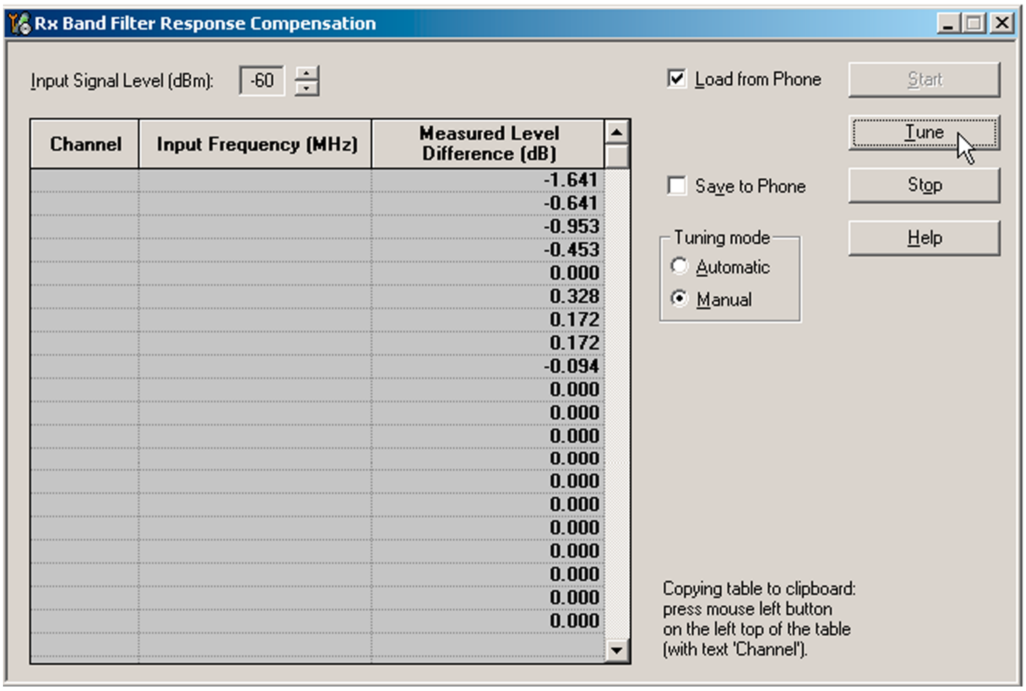
☐ Save to Phone

Tuning mode
○ Automatic
● Manual

Channel	Input Frequency (MHz)	Measured Level Difference (dB)

Copying table to clipboard: press mouse left button on the left top of the table (with text 'Channel').

6. Click Tune.



Input Signal Level (dBm): -60

☑ Load from Phone

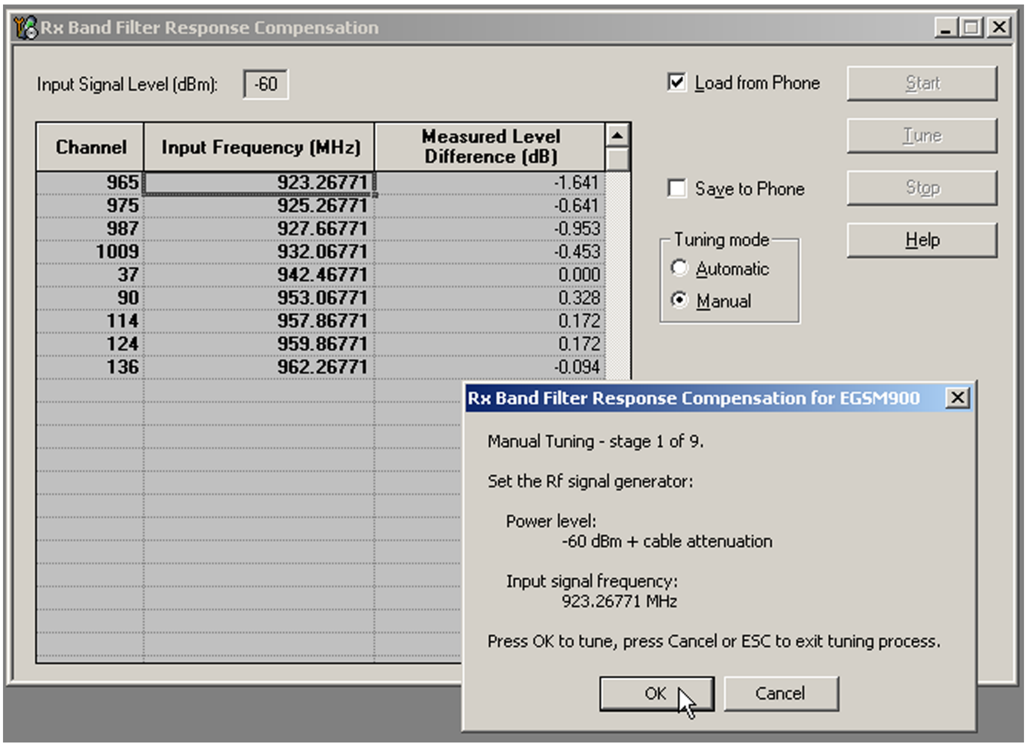
☐ Save to Phone

Tuning mode
○ Automatic
● Manual

Channel	Input Frequency (MHz)	Measured Level Difference (dB)
		-1.641
		-0.641
		-0.953
		-0.453
		0.000
		0.328
		0.172
		0.172
		-0.094
		0.000
		0.000
		0.000
		0.000
		0.000
		0.000
		0.000
		0.000
		0.000
		0.000
		0.000

Copying table to clipboard: press mouse left button on the left top of the table (with text 'Channel').

7. Connect signal generator to the phone and set frequency and amplitude as instructed in the "Rx Band Filter Response Compensation for EGSM900" popup window.



Input Signal Level (dBm): -60

☑ Load from Phone

☐ Save to Phone

Tuning mode
○ Automatic
● Manual

Channel	Input Frequency (MHz)	Measured Level Difference (dB)
965	923.26771	-1.641
975	925.26771	-0.641
987	927.66771	-0.953
1009	932.06771	-0.453
37	942.46771	0.000
90	953.06771	0.328
114	957.86771	0.172
124	959.86771	0.172
136	962.26771	-0.094

Rx Band Filter Response Compensation for EGSM900

Manual Tuning - stage 1 of 9.

Set the Rf signal generator:

Power level:
-60 dBm + cable attenuation

Input signal frequency:
923.26771 MHz

Press OK to tune, press Cancel or ESC to exit tuning process.

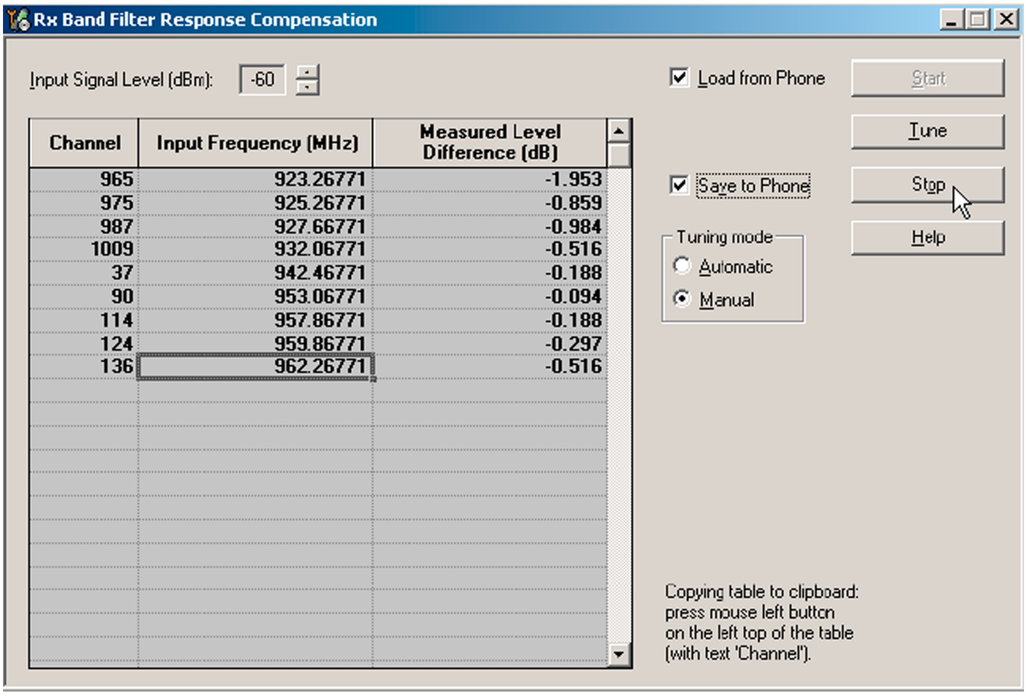
8. To perform tuning, click OK.
9. Go through all 9 frequencies.

10. Check that the tuning values are within the limits specified in this table:

	Min	Typ	Max	Unit
GSM850				
Ch. 118 / 867.26771 MHz	-10	-1	5	dB
Ch. 128 / 869.26771 MHz	-3	0	5	dB
Ch. 140 / 871.66771 MHz	-3	0	5	dB
Ch. 172 / 878.06771 MHz	-3	0	5	dB
Ch. 190 / 881.66771 MHz	-3	0	5	dB
Ch. 217 / 887.06771 MHz	-3	0	5	dB
Ch. 241 / 891.86771 MHz	-3	0	5	dB
Ch. 251 / 893.86771 MHz	-3	0	5	dB
Ch. 261/ 895.86771 MHz	-10	-1	5	dB
GSM900				
Ch. 965 / 923.26771 MHz	-10	-1	5	dB
Ch. 975 / 925.26771 MHz	-3	0	5	dB
Ch. 987 / 927.66771 MHz	-3	0	5	dB
Ch. 1009 / 932.06771 MHz	-3	0	5	dB
Ch. 37 / 942.46771 MHz	-3	0	5	dB
Ch. 90 / 953.06771 MHz	-3	0	5	dB
Ch. 114 / 957.86771 MHz	-3	0	5	dB
Ch. 124 / 959.86771 MHz	-3	0	5	dB
Ch. 136 / 962.26771 MHz	-10	-1	5	dB
GSM1800				

	Min	Typ	Max	Unit
Ch. 497 / 1802.26771 MHz	-10	-1	5	dB
Ch. 512 / 1805.26771 MHz	-3	0	5	dB
Ch. 535 / 1809.86771 MHz	-3	0	5	dB
Ch. 606 / 1824.06771 MHz	-3	0	5	dB
Ch. 700 / 1842.86771 MHz	-3	0	5	dB
Ch. 791 / 1861.06771 MHz	-3	0	5	dB
Ch. 870 / 1876.86771 MHz	-3	0	5	dB
Ch. 885 / 1879.86771 MHz	-3	0	5	dB
Ch. 908 / 1884.46771 MHz	-10	-1	5	dB
GSM1900				
Ch. 496 / 1927.06771 MHz	-10	-1	5	dB
Ch. 512 / 1930.26771 MHz	-3	0	5	dB
Ch. 537 / 1935.26771 MHz	-3	0	5	dB
Ch. 586 / 1945.06771 MHz	-3	0	5	dB
Ch. 661 / 1960.06771 MHz	-3	0	5	dB
Ch. 736 / 1975.06771 MHz	-3	0	5	dB
Ch. 794 / 1986.66771 MHz	-3	0	5	dB
Ch. 810 / 1989.86771 MHz	-3	0	5	dB
Ch. 835 / 1994.86771 MHz	-10	-1	5	dB

11. Check the "Save to Phone" check box and click Stop if the values are within the limits.


Rx Band Filter Response Compensation
Start
Tune
Stop
Help

Input Signal Level (dBm): -60

☑ Load from Phone

☑ Save to Phone

Tuning mode
○ Automatic
● Manual

Channel	Input Frequency (MHz)	Measured Level Difference (dB)
965	923.26771	-1.953
975	925.26771	-0.859
987	927.66771	-0.984
1009	932.06771	-0.516
37	942.46771	-0.188
90	953.06771	-0.094
114	957.86771	-0.188
124	959.86771	-0.297
136	962.26771	-0.516

Copying table to clipboard: press mouse left button on the left top of the table (with text 'Channel').

Next actions

Repeat the steps 4 to 10 for GSM850, GSM1800 and GSM1900.

GSM transmitter tunings

Tx IQ tuning (GSM)

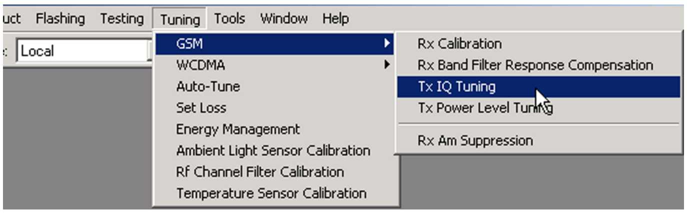
Context

The Tx path branches to I and Q signals at RF I/Q modulator. Modulator and analog hardware located after it cause unequal amplitude and phase disturbance to I and Q signal paths. Tx IQ tuning tuning balances the I and Q branches.

Tx IQ tuning must be performed on all GSM bands. .

Steps

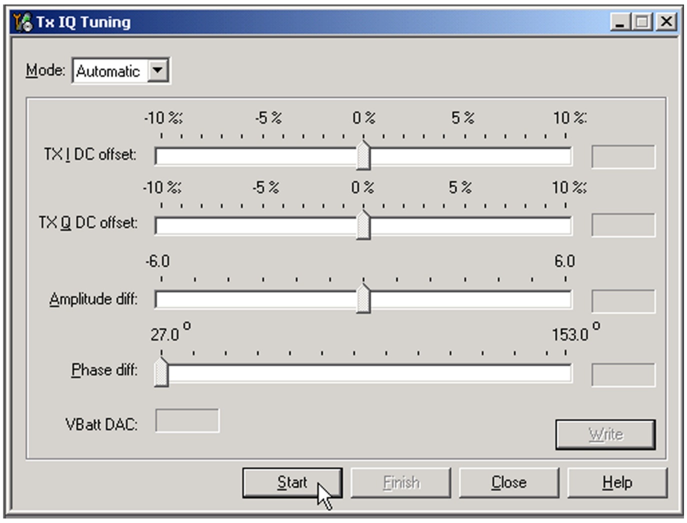
1. From the dropdown menus, set "Operating mode" to Local, "System mode" to GSM, and Band to GSM900.
2. From the Tuning menu, choose GSM -> Tx IQ Tuning.


uct
Flashing
Testing
Tuning
Tools
Window
Help
Local
GSM
WCDMA
Auto-Tune
Set Loss
Energy Management
Ambient Light Sensor Calibration
Rf Channel Filter Calibration
Temperature Sensor Calibration
Rx Calibration
Rx Band Filter Response Compensation
Tx IQ Tuning
Tx Power Level Tuning
Rx Am Suppression

3. Set Mode to Automatic and Edge to Off.
4. Click Start.

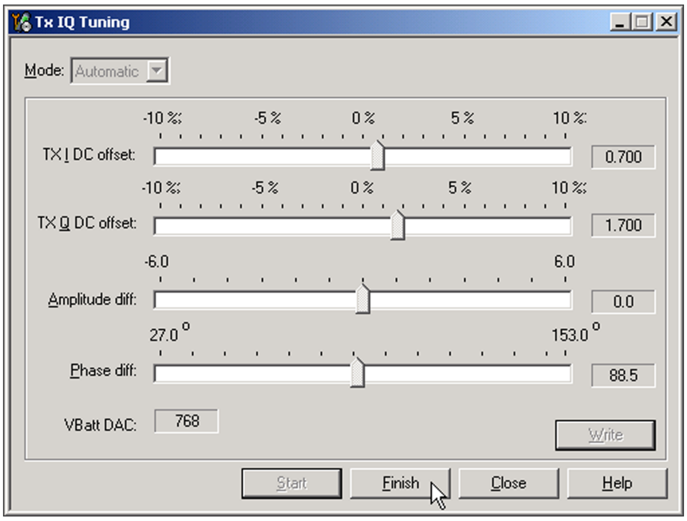
   Wait until automatic tuning has finished and moved the sliders.

   Values are written to the phone memory automatically.


Tx IQ Tuning
-10 %
-5 %
0 %
5 %
10 %
TX I DC offset:
TX Q DC offset:
-6.0
6.0
Amplitude diff:
27.0 °
153.0 °
Phase diff:
VBatt DAC:
Write
Start
Finish
Close
Help

Mode: Automatic

5. When the values have been written to the phone memory, click the Finish button to end the tuning.


Tx IQ Tuning
-10 %
-5 %
0 %
5 %
10 %
-6.0
6.0
27.0 °
153.0 °
Write
Start
Finish
Close
Help

Mode: Automatic

TX I DC offset: 0.700

TX Q DC offset: 1.700

Amplitude diff: 0.0

Phase diff: 88.5

VBatt DAC: 768

6. Change band to GSM850 and repeat steps 4 to 5.
7. Change band to GSM1800 and repeat steps 4 to 5.
8. Change band to GSM1900 and repeat steps 4 to 5.
9. To close the tuning window, click Close.

Next actions

Tuning sliders should be close to the center of the scale after the tuning and within the limits specified in the table below. If they are not within the limits, check Tx IQ quality manually.

	Min	Typ	Max	Unit
GSM850				
I DC offset / Q DC offset	-6	-4	6	%
Ampl	-1	0	1	dB
Phase	85	90	95	○
GSM900				

	Min	Typ	Max	Unit
I DC offset / Q DC offset	-6	-4	6	%
Ampl	-1	0	1	dB
Phase	85	90	95	○
GSM1800/GSM1900				
I/Q DC	-6	0.5	6	%
Ampl	-1	0	1	dB
Phase	95	100	110	○

Tx power level tuning (GSM)

Context

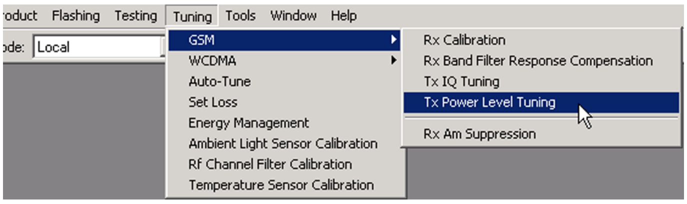
Because of variations at IC process and discrete component values, actual transmitter RF gain of each phone is different. Tx power level tuning is used to find out mapping factors called 'power coefficients'. These adjust the GSM transmitter output power to fulfill the specifications.

For EDGE transmission the bias settings of the FEM are adjusted in order to improve linearity. This affects the PA gain and hence the power levels have to be aligned separately for EDGE transmission.

Tx power level tuning has to be performed on all GSM bands.

Steps

1. Connect the phone to a spectrum analyzer.
2. From the dropdown menus, set "Operating mode" to Local, "System mode" to GSM, and Band to GSM900.
3. From the Tuning menu, choose GSM -> Tx Power Level Tuning.


roduct
Flashing
Testing
Tuning
Tools
Window
Help
ode:
Local
GSM
WCDMA
Auto-Tune
Set Loss
Energy Management
Ambient Light Sensor Calibration
Rf Channel Filter Calibration
Temperature Sensor Calibration
Rx Calibration
Rx Band Filter Response Compensation
Tx IQ Tuning
Tx Power Level Tuning
Rx Am Suppression

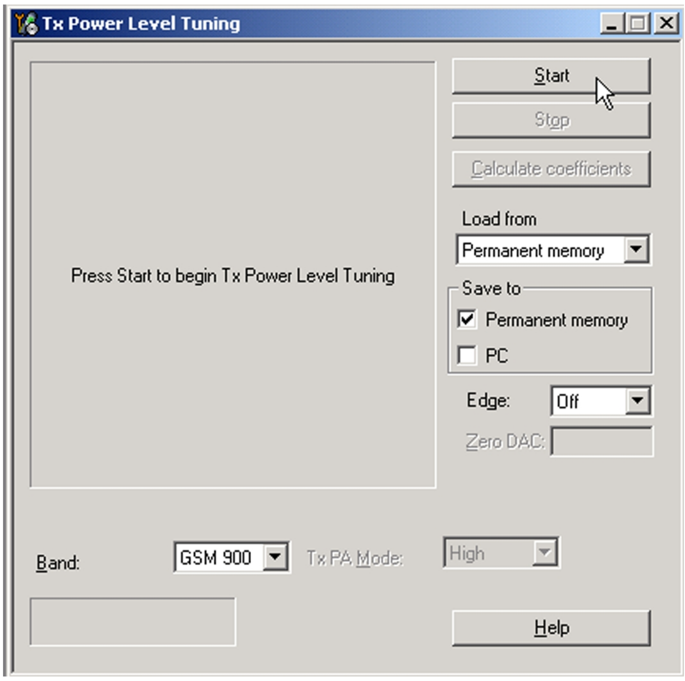
4. Set Mode to Automatic and Edge to Off.
5. Set the spectrum analyzer for power level tuning:

Frequency	channel frequency (836.6MHz GSM850, 897.4MHz GSM900, 1747.8MHz GSM1800, 1880MHz GSM1900)
Span	0 Hz
Sweep time	2ms
Trigger	Video triggering (-10dBm)
Resolution BW	3MHz
Video BW	3MHz

Reference level offset	sum cable attenuation with module jig attenuation
Reference level	33dBm

A power meter with a peak power detector can be also used. Remember to take the attenuations in the account!

6. Click Start.



Tx Power Level Tuning
Start
Stop
Calculate coefficients
Help

Press Start to begin Tx Power Level Tuning

Load from: Permanent memory

Save to:
☑ Permanent memory
☐ PC

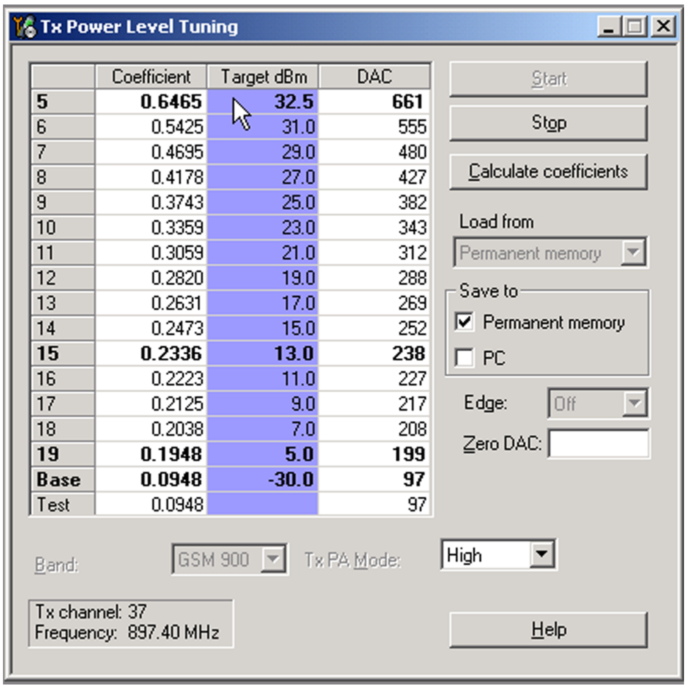
Edge: Off

Zero DAC:

Band: GSM 900

Tx PA Mode: High

7. Adjust power levels 5, 15 and 19 to correspond the "Target dBm" column by pressing + or – keys.



Tx Power Level Tuning
Start
Stop
Calculate coefficients
Help

	Coefficient	Target dBm	DAC
5	**0.6465**	**32.5**	**661**
6	0.5425	31.0	555
7	0.4695	29.0	480
8	0.4178	27.0	427
9	0.3743	25.0	382
10	0.3359	23.0	343
11	0.3059	21.0	312
12	0.2820	19.0	288
13	0.2631	17.0	269
14	0.2473	15.0	252
15	**0.2336**	**13.0**	**238**
16	0.2223	11.0	227
17	0.2125	9.0	217
18	0.2038	7.0	208
19	**0.1948**	**5.0**	**199**
Base	**0.0948**	**-30.0**	**97**
Test	0.0948		97

Load from: Permanent memory

Save to:
☑ Permanent memory
☐ PC

Edge: Off

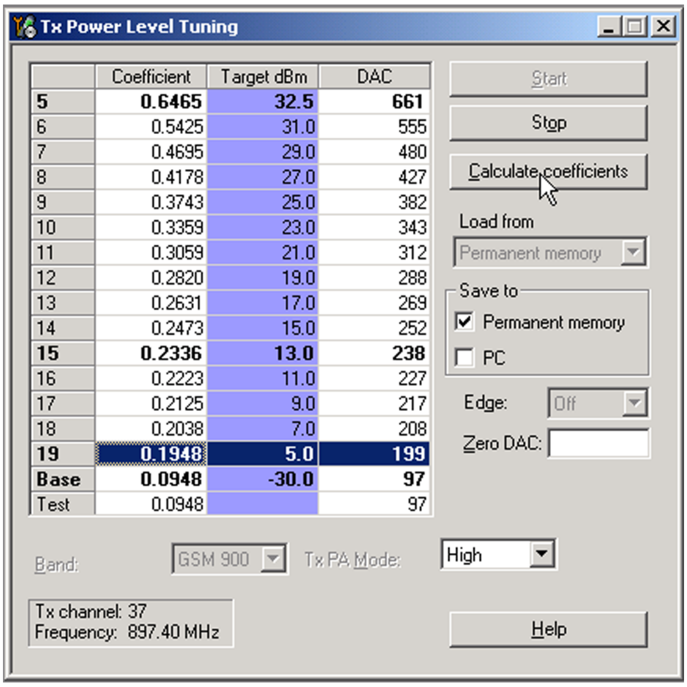
Zero DAC:

Band: GSM 900

Tx PA Mode: High

Tx channel: 37
Frequency: 897.40 MHz

8. Click Calculate Coefficients.



	Coefficient	Target dBm	DAC
5	**0.6465**	**32.5**	**661**
6	0.5425	31.0	555
7	0.4695	29.0	480
8	0.4178	27.0	427
9	0.3743	25.0	382
10	0.3359	23.0	343
11	0.3059	21.0	312
12	0.2820	19.0	288
13	0.2631	17.0	269
14	0.2473	15.0	252
15	**0.2336**	**13.0**	**238**
16	0.2223	11.0	227
17	0.2125	9.0	217
18	0.2038	7.0	208
19	**0.1948**	**5.0**	**199**
Base	**0.0948**	**-30.0**	**97**
Test	0.0948		97

Load from: Permanent memory

Save to:
☑ Permanent memory
☐ PC

Edge: Off

Zero DAC:

Band: GSM 900

Tx PA Mode: High

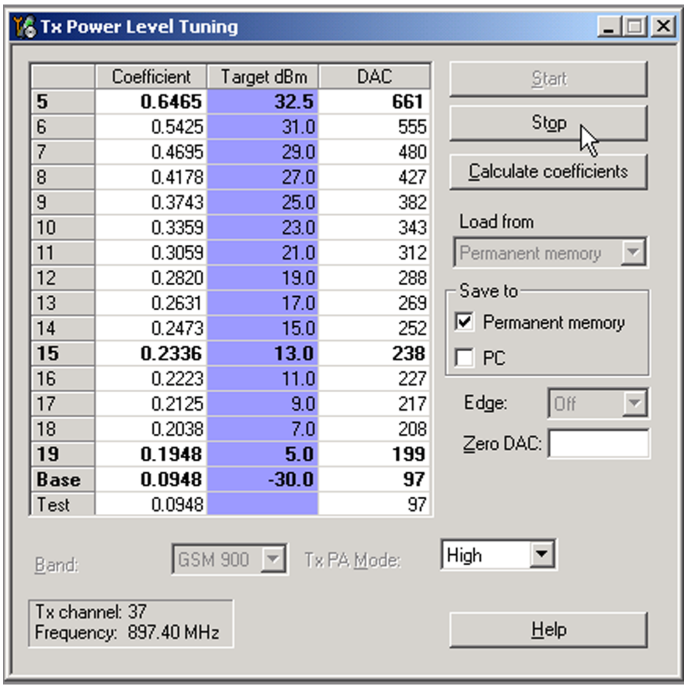
Tx channel: 37
Frequency: 897.40 MHz

9. Check that the coeffiecient values are within the limits specified in the following table.

	Min	Typ	Max
GSM850 EDGE off			
PL5 coefficient	0.45	0.626	0.73
PL15 coefficient		0.234	
PL19 coefficient	0.12	0.195	0.3
GSM850 EDGE on			
PL8 coefficient	0.35	0.419	0.6
PL15 coefficient		0.247	
PL19 coefficient	0.12	0.204	0.3
GSM900 EDGE off			
PL5 coefficient	0.45	0.626	0.73
PL15 coefficient		0.234	
PL19 coefficient	0.12	0.195	0.3
GSM900 EDGE on			
PL8 coefficient	0.35	0.419	0.6
PL15 coefficient		0.247	
PL19 coefficient	0.12	0.204	0.3
GSM1800 EDGE off			
PL0 coefficient	0.45	0.51	0.7

	Min	Typ	Max
PL11 coefficient		0.219	
PL15 coefficient	0.12	0.185	0.3
GSM1800 EDGE on			
PL2 coefficient	0.35	0.394	0.6
PL11 coefficient		0.23	
PL15 coefficient	0.12	0.194	0.3
GSM1900 EDGE off			
PL0 coefficient	0.45	0.482	0.7
PL11 coefficient		0.218	
PL15 coefficient	0.12	0.184	0.3
GSM1900 EDGE on			
PL2 coefficient	0.35	0.377	0.6
PL11 coefficient		0.23	
PL15 coefficient	0.12	0.193	0.3

If the values are within the limits, check that the "Save to Phone Permanent Memory" check box is checked and click Stop.



	Coefficient	Target dBm	DAC
5	**0.6465**	**32.5**	**661**
6	0.5425	31.0	555
7	0.4695	29.0	480
8	0.4178	27.0	427
9	0.3743	25.0	382
10	0.3359	23.0	343
11	0.3059	21.0	312
12	0.2820	19.0	288
13	0.2631	17.0	269
14	0.2473	15.0	252
15	**0.2336**	**13.0**	**238**
16	0.2223	11.0	227
17	0.2125	9.0	217
18	0.2038	7.0	208
19	**0.1948**	**5.0**	**199**
Base	**0.0948**	**-30.0**	**97**
Test	0.0948		97

Load from: Permanent memory

Save to:
☑ Permanent memory
☐ PC

Edge: Off

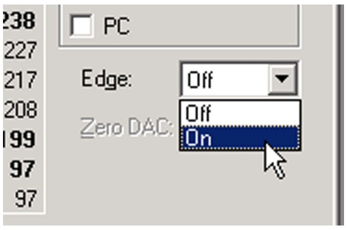
Zero DAC:

Band: GSM 900

Tx PA Mode: High

Tx channel: 37
Frequency: 897.40 MHz

10. Set **Edge** mode on and start tuning again. Change video averaging to 50.



11. Tune EDGE power levels to the corresponding target power levels.

    Only power levels **8**, **15** and **19** are tuned in GSM900 and **2**, **10** and **15** in GSM1800/1900. The rest are calculated by clicking the Calculate Coefficients button. Check the coefficients against the RF tuning limits table presented in Step 9.

12. When the tuning is completed, click Stop.

Next actions

Repeat steps 4 to 9 for GSM1800 and GSM1900. On those bands only power levels **0**, **11** and **15** need to be tuned.

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8 — Camera Module Troubleshooting

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Introduction to camera module troubleshooting

Note: All subsequent references to camera concern RM-170 only, there is no camera in RM-171.

Background, tools and terminology

Faults or complaints in camera operation can be roughly categorised into three subgroups:

1. Camera is not functional at all; no image can be taken.
2. Images can be taken but there is nothing recognizable in them.
3. Images can be taken and they are recognizable but for some reason the quality of images is seriously degraded.

Image quality is very hard to measure quantitatively, and even comparative measurements are difficult (comparing two images) to do, if the difference is small. Especially if the user is not satisfied with his/her device's image quality, and tells, for example, that the images are not sharp, it is fairly difficult to accurately test the device and get an exact figure which would tell whether the device is functioning properly.

Often subjective evaluation has to be used for finding out if a certain property of the camera is acceptable or not. Some training or experience of a correctly operating reference device may be needed in order to detect what actually is wrong.

It is easy for the user to take bad images in bad conditions. Therefore the camera operation has to be checked always in constant conditions (lighting, temperature) or by using a second, known-to-be good device as reference.

When checking for possible errors in camera functionality, knowing what error is suspected significantly helps the testing by narrowing down the amount of test cases. The following types of image quality problems may be expected to appear:

- Dust (black spots)
- Lack of sharpness
- Bit errors

Terms

Dynamic range	Camera's ability to capture details in dark and bright areas of the scene simultaneously.
Exposure time	Camera modules use silicon sensor to collect light and for forming an image. The imaging process roughly corresponds to traditional film photography, in which exposure time means the time during which the film is exposed to light coming through optics. Increasing the time will allow for more light hitting the film and thus results in brighter image. The operation principle is exactly the same with silicon sensor, but the shutter functionality is handled electronically i.e. there is no mechanical moving parts like in film cameras.
Flicker	Phenomenon, which is caused by pulsating in scene lighting, typically appearing as wide horizontal stripes in an image.
Noise	Variation of response between pixels with same level of input illumination.
Resolution	Usually the amount of pixels in the camera sensor; for example, RM-10/ RM-24 has a 1600 x 1200 pixel sensor resolution. In some occasions the term resolution is used for describing the sharpness of the images.

Sensitivity	Camera module's sensitivity to light. In equivalent illumination conditions, a less sensitive camera needs a longer exposure time to gather enough light in forming a good image. Analogous to ISO speed in photographic film.
Sharpness	Good quality images are 'sharp' or 'crisp', meaning that image details are well visible in the picture. However, certain issues, such as non-idealities in optics, cause image blurring, making objects in picture to appear 'soft'. Each camera type typically has its own level of performance.

The effect of image taking conditions on image quality

There are some factors, which may cause poor image quality, if not taken into account by the end user when shooting images, and thus may result in complaints. The items listed are normal to camera operation and are not a reason for changing the camera module.

Distance to target

The lens in the module is specified to operate satisfactorily from 64 cm to infinite distance of scene objects. In practice, the operation is such that close objects may be noticed to get more blurred when distance to them is shorter than 64 cm. The lack of sharpness is first visible in full resolution images. If observing just the viewfinder, even very close objects may seem to appear sharp. This is normal; do not change the camera module.

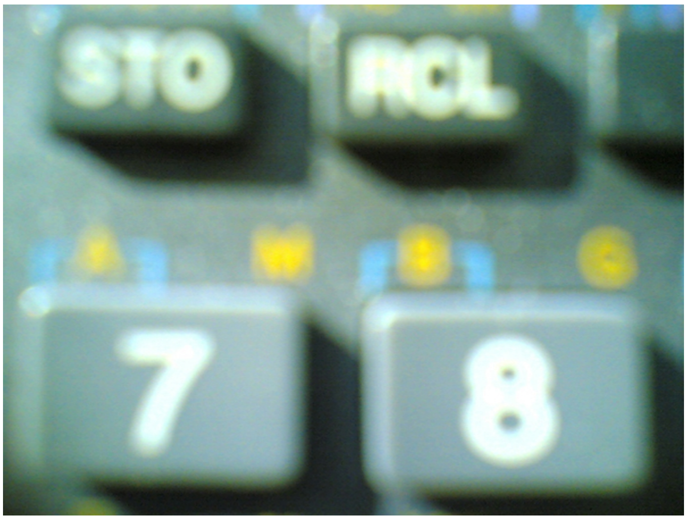


Figure 52 Blurred image. Target too close.

The amount of light available

In dim conditions camera runs out of sensitivity. The exposure time is long (especially in the night mode) and the risk of getting shaken (= blurred) images increases. In addition, image noise level grows. The maximum exposure time in the night mode is ¼ seconds. Therefore, images need to be taken with extreme care and by supporting the phone when the amount of light reflected from the target is low. Because of the longer exposure time and larger gain value, noise level increases in low light conditions. Sometimes blurring may even occur in daytime, if the image is taken very carelessly. See the figure below for an example. This is normal; do not change the camera module.

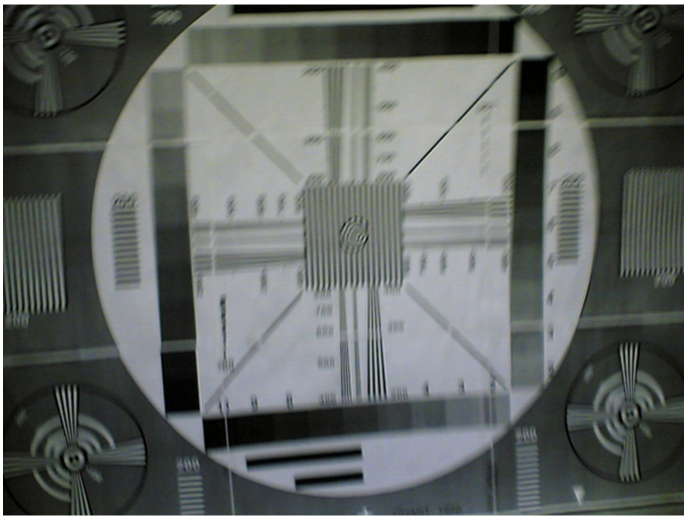


Figure 53 Blurring caused by shaking hands

Movement in bright light

If an image is taken of moving objects or if the device is used in a moving vehicle, object 'skewing' or 'tilting' may occur. This phenomenon is fundamental to most CMOS camera types, and usually cannot be avoided. The movement of camera or object sometimes cause blurring indoors or in dim lighting conditions because of long exposure time. This is normal; do not change the camera module.

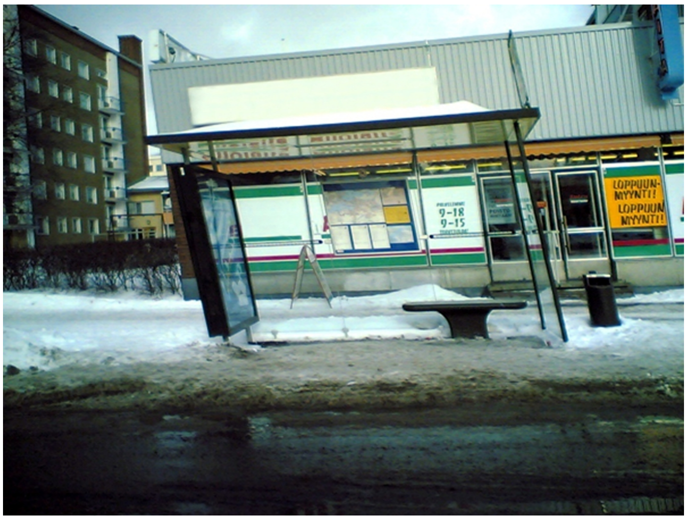


Figure 54 Near objects get skewed when taking images from a moving vehicle

Temperature

High temperatures inside the mobile phone cause more noise to appear in images. For example, in +70 degrees (Celsius), the noise level may be very high, and it further grows if the conditions are dim. If the phone processor has been heavily loaded for a long time before taking an image, the phone might have considerably higher temperature inside than in the surrounding environment. This is also normal to camera operation; do not change the camera module.

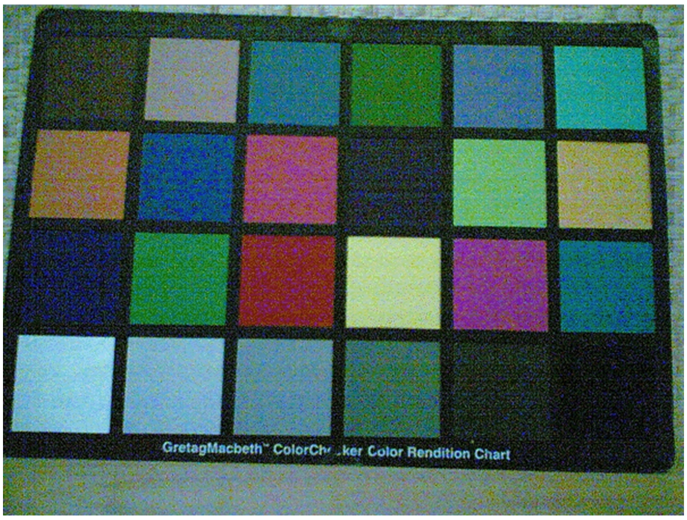


Figure 55 Noisy image taken in +70 degrees Celsius

Phone display

If the display contrast is set too dark, the image quality degrades: the images may be very dark depending on the setting. If the display contrast is set too bright, image contrast appears bad and "faint". This problem is solved by setting the display contrast correctly. This is normal behaviour; do not change the camera module.

Basic rules of photography (especially shooting against light)

Because of dynamic range limitations, taking images against bright light might cause either saturated image or the actual target appear too dark. In practice, this means that when taking an image indoors and having, for example, a window behind the object, the result is usually poor. This is normal behaviour; do not change the camera module.

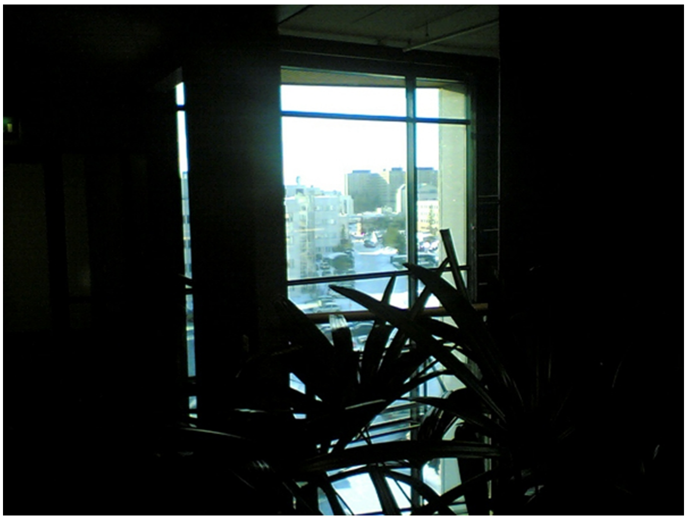


Figure 56 Image taken against light

Flicker

In some occasions a bright fluorescent light may cause flicker in the viewfinder and captured image. This phenomenon may also be a result, if images are taken indoors under the mismatch of 50/60 Hz electricity network frequency. The electricity frequency used is automatically detected by the camera module. In some very few countries, both 50 and 60 Hz networks are present and thus probability for the phenomenon increases. Flickering occurs also under high artificial illumination level. This is normal behaviour; do not change the camera module.

Figure 57 Flicker in an image; object illuminated by strong fluorescent light

Bright light outside of image view

Especially the sun can cause clearly visible lens glare phenomenon and poor contrast in images. This happens because of undesired reflections inside the camera optics. Generally this kind of reflections are common in all optical systems. This is normal behaviour; do not change the camera module.

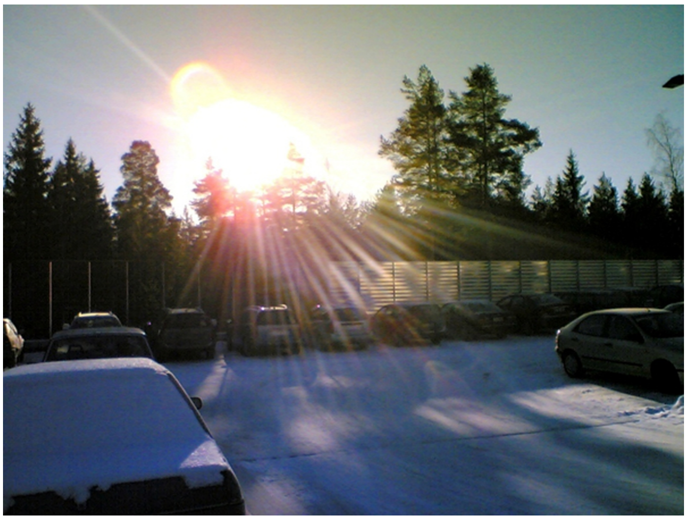


Figure 58 A lens reflection effect caused by sunshine

Examples of good quality images

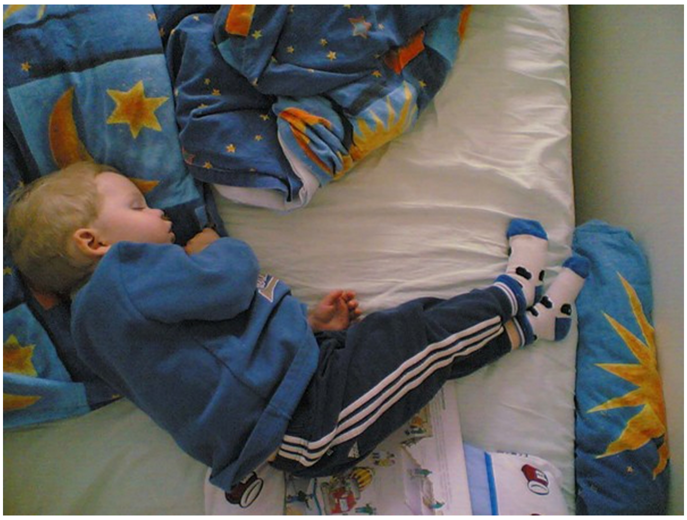


Figure 59 Good image taken indoors

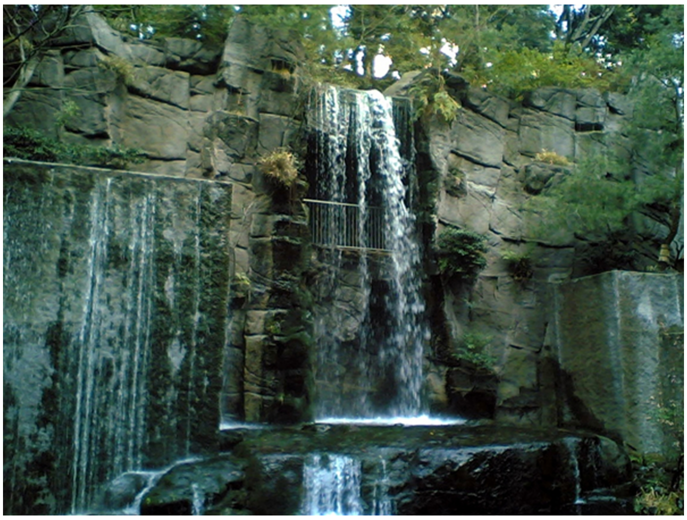


Figure 60 Good image taken outdoors

Camera construction

This section describes the mechanical construction of the camera module for getting a better understanding of the actual mechanical structure of the module.

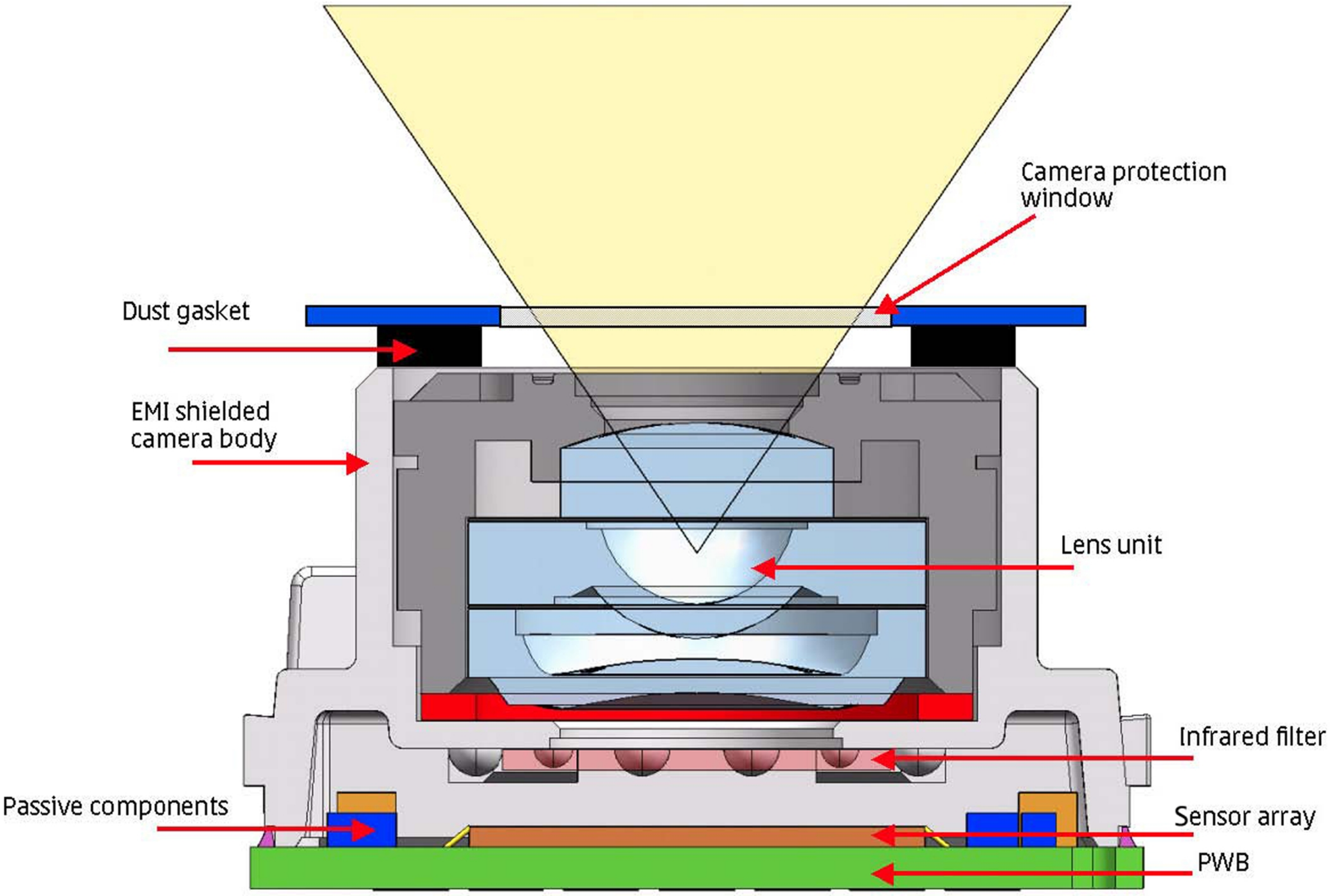

Camera protection window
Dust gasket
EMI shielded camera body
Lens unit
Infrared filter
Passive components
Sensor array
PWB

Figure 61 Camera module cross section and assembly principle

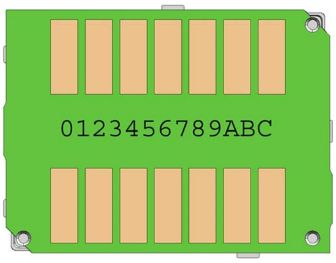

0123456789ABC

Figure 62 Camera module bottom view including serial numbering

The camera module as a component is not a repairable part, meaning that the components inside the module may not be changed. Cleaning dust from the front face is allowed only. Use clean compressed air.

The camera module uses socket type connecting. For versioning, laser marked serial numbering is used on the PWB.

The main parts of the module are:

- Lens unit including lens aperture.
- Infrared filter; used to prevent infrared light from contaminating the image colors. The IR filter is glued to the EMI shielded camera body.
- Camera body; made of conductive metallized plastic and attached to the PWB with glue.
- Sensor array including DSP functions is glued and wire-bonded to the PWB.
- PWB, FR-4 type
- Socket type connection

- Laser-marked serial numbering on PWB (for versioning)
- Passive components
- Camera protection window; part of the phone cover mechanics
- Dust gasket between the lens unit and camera protection window

Image quality analysis

Testing for dust in camera module

Symptoms and diagnosis

For detecting dust problems, take an image of a uniform white surface and analyse it in full resolution. A good quality PC CRT monitor is preferred for analysis (avoid using LCD). Search carefully because finding these defects is not always easy. Figure "Effects of dust on optical path" is an example of an image having easily detectable dust problems.

When taking a white image, use uniformly lightened white paper or white wall. Another option is to use uniform light but in this case make sure that the camera image is not flickering when taking the test image. In case flickering occurs, try to reduce the illumination level. Use JPEG image format for analysing, and set the image quality parameter to ‘High Quality’.

Black spots in an image are caused by dirt particles trapped inside the optical system. Clearly visible and sharp edged black dots in an image are typically dust particles on the image sensor. These spots are searched for in the manufacturing phase, but it is possible that the camera body cavity contains a particle, which may move onto the image sensor active surface, for example, when the phone is dropped. Therefore it is also possible that the problem will disappear before the phone is brought to service. The camera should be replaced if the problem is present when the service technician analyses the phone.

If dust particles are lying on the infrared filter surface on either side, they are hard to locate because they are out of focus, and appear in the image as large, grayish and fading-edge 'blobs'. Sometimes they are invisible to the eye, and the user probably does not notice them at all. However, it is possible that a larger particle disturbs the user, causing need for service.

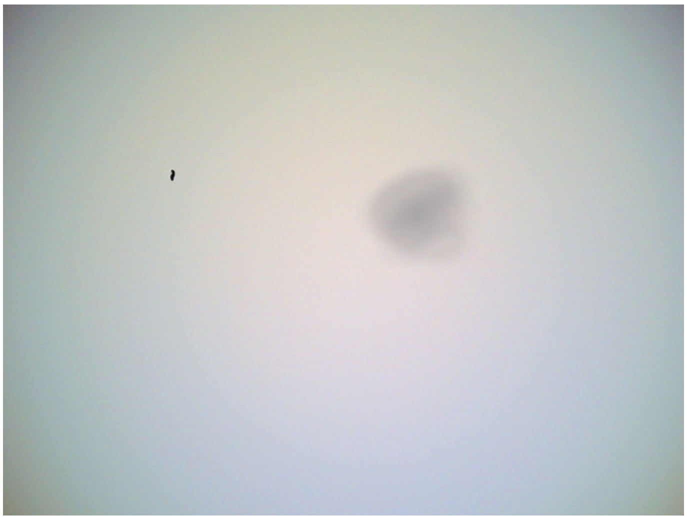


Figure 63 Effects of dust on optical path

If large dust particles get trapped on top of the lens surface in the cavity between the camera window and the lens, they will cause image blurring and poor contrast. If dust stays on the camera module surface, camera cussion, camera bezel or window at assembling, dust may sneak into the optical system as the optical zoom or Auto focus lens moves back and forth. The camera cussion and bezel between the window and the lens unit or camera module should prevent any particles from getting into the cavity after the manufacturing phase.

If dust particles are found on the sensor, this is classified as a manufacturing error of the module, and the camera should be replaced. Any particles inside the cavity between the protection window and the lens have most probably been trapped there in the assembly phase at a Nokia factory. Unauthorized disassembling of the product can also be the root of the problem. However, in most cases it should be possible to remove the particle(s) by using clean compressed air. Never wipe the lens surface before trying compressed air; the possibility of damaging the lens is substantial. Always check the image sharpness after removing dust.

Testing camera image sharpness

Symptoms and diagnosis

If pictures taken with a device are claimed to be blurry, there are six possible sources for the problem:

1 The protection window is fingerprinted, soiled, dirty, visibly scratched or broken.

2 The photographed object is too close – the camera lens operates with distances from 64 cm to infinity. This is no cause to replace camera module.

3 User has tried to take pictures in too dark conditions, and images are blurred due to handshake or movement. This is no cause to replace camera module.

4 There is dirt between the protection window and camera lens.

5 The protection window is defective. This can be either a manufacturing failure or caused by the user. The window should be changed.

6 The camera lens is misfocused because of a manufacturing error.

A quantitative analysis of sharpness is very difficult to conduct in any other environment than optics laboratory. Therefore, subjective analysis should be used.

If no visible defects (items 1-4) are found, a couple of test images should be taken. Generally, a well-illuminated typical indoor scene can be used as a target. The main considerations are:

- The protection window has to be clean.
- The amount of light (300 – 600 lux (bright office lighting)) is sufficient.
- The scene should contain, for example, small objects for checking sharpness. Their distance should be 1 – 2 meters.
- If possible, compare the image to another image of the same scene, taken with a different device. Note that the reference device has to be a similar Nokia phone.

Steps

1. Take several images of small objects in the distance of 1-2 metres.
2. Analyse the images on a PC screen at 100% scaling with the reference images.

   Pay attention to the computer display settings: at least 65000 colors (16-bit) have to be used. True colour (24-bit, 16 million colours) or 32-bit (full colour) setting is recommended.

Next actions

If there appears to be a clearly noticeable difference between the reference image and the test images, the module might have a misfocused lens -> change the module.

Re-check the resolution after changing the camera module.

If the changed module produces the same result, the fault is probably in the camera window. Check the window by looking carefully through it when replacing the module.

Dirty camera lens protection window

The following series of images demonstrates the effects of fingerprints on the camera protection window.

It should be noted that the effects of any dirt in images can vary much. It may be difficult to judge whether the window has been dirty or if something else is wrong. Therefore, the cleanness of the protection window should always be checked and the window should be wiped clean with a suitable cloth.

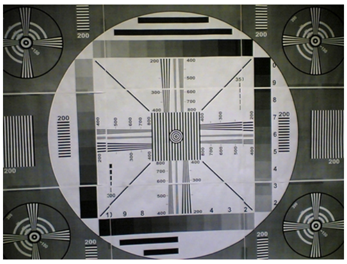


Figure 64 Image taken with clean protection window

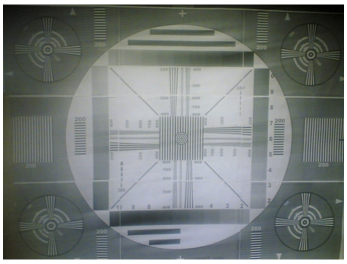


Figure 65 Image taken with greasy protection window

Image bit errors

Bit errors are image defects caused by data transmission errors between the camera module and the phone baseband and/or errors inside the module.

Usually bit errors can be easily detected in images, and they are best visible in full resolution images. A good practice is to use a uniform white test target when analysing these errors. The errors are clearly visible, colourful sharp dots or lines in camera images. See the following figure.

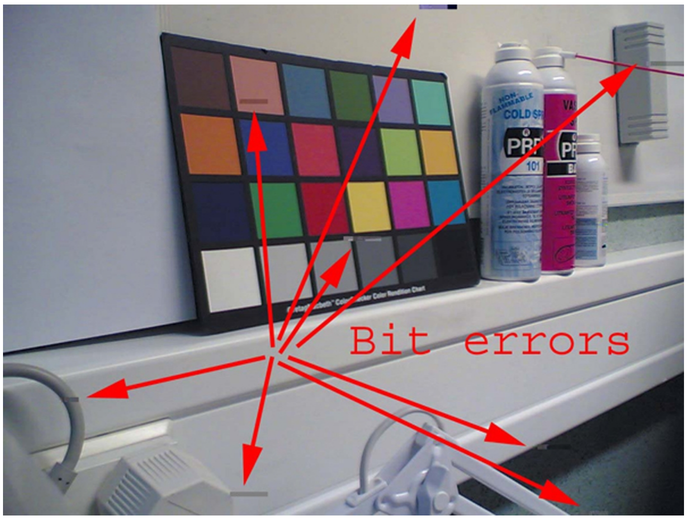


Figure 66 Bit errors caused by JPEG compression

One type of bit error is a lack of bit depth. In this case, the image is almost totally black under normal conditions, and only senses something in very highly illuminated environments. Typically this is a contact problem between the camera module and the phone main PWB. You should check the camera assembly and connector contacts.

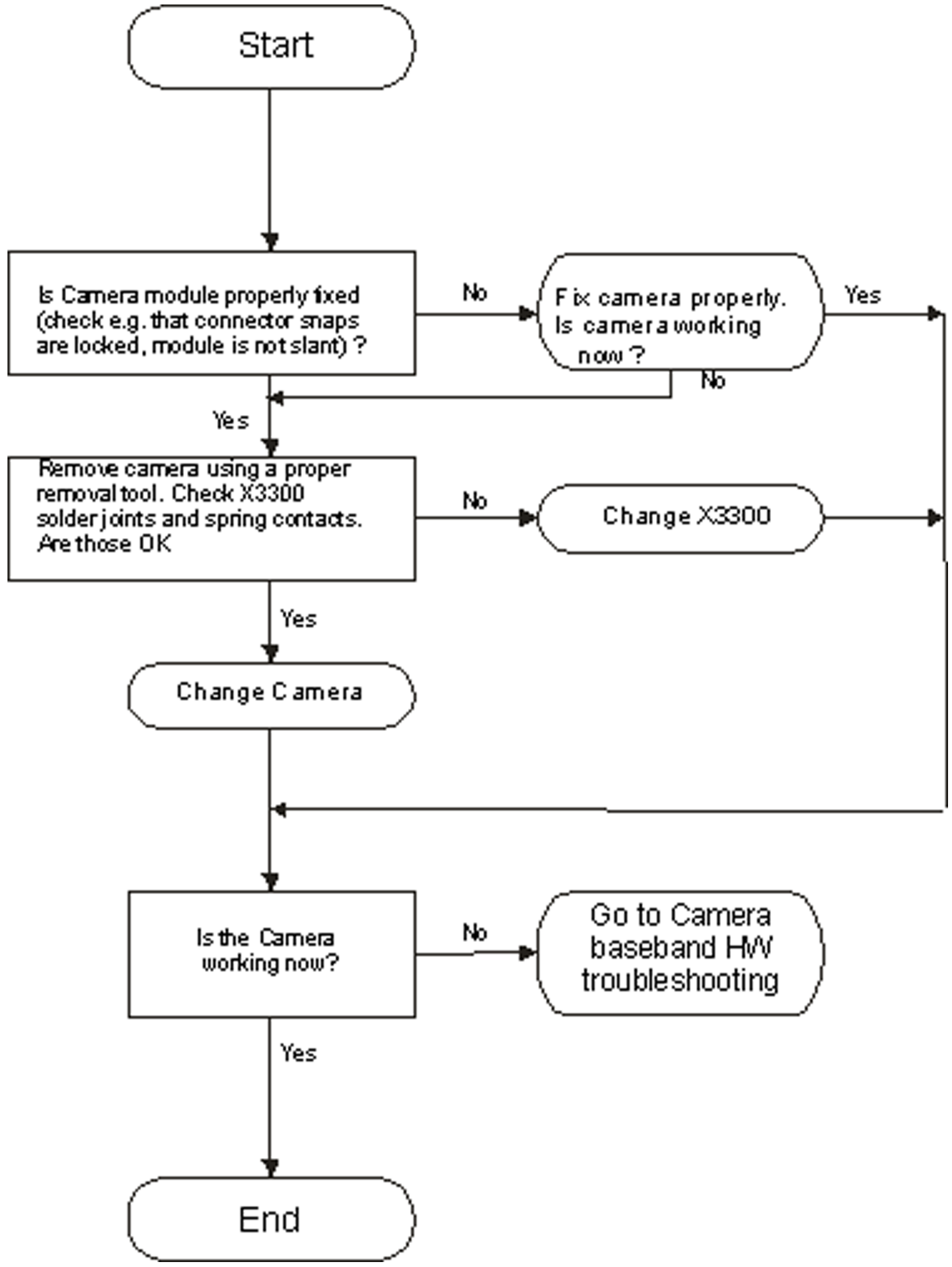
If the fault is in the camera module, bit errors are typically visible only when using some specific image resolution. For example, in case of a viewfinder fault, the error might exist but is not visible in a full size image.

> **Note:** At the most 5 clusters of black dots or blemish are not considered errors, and no reason to replace camera module

Camera troubleshooting flowcharts

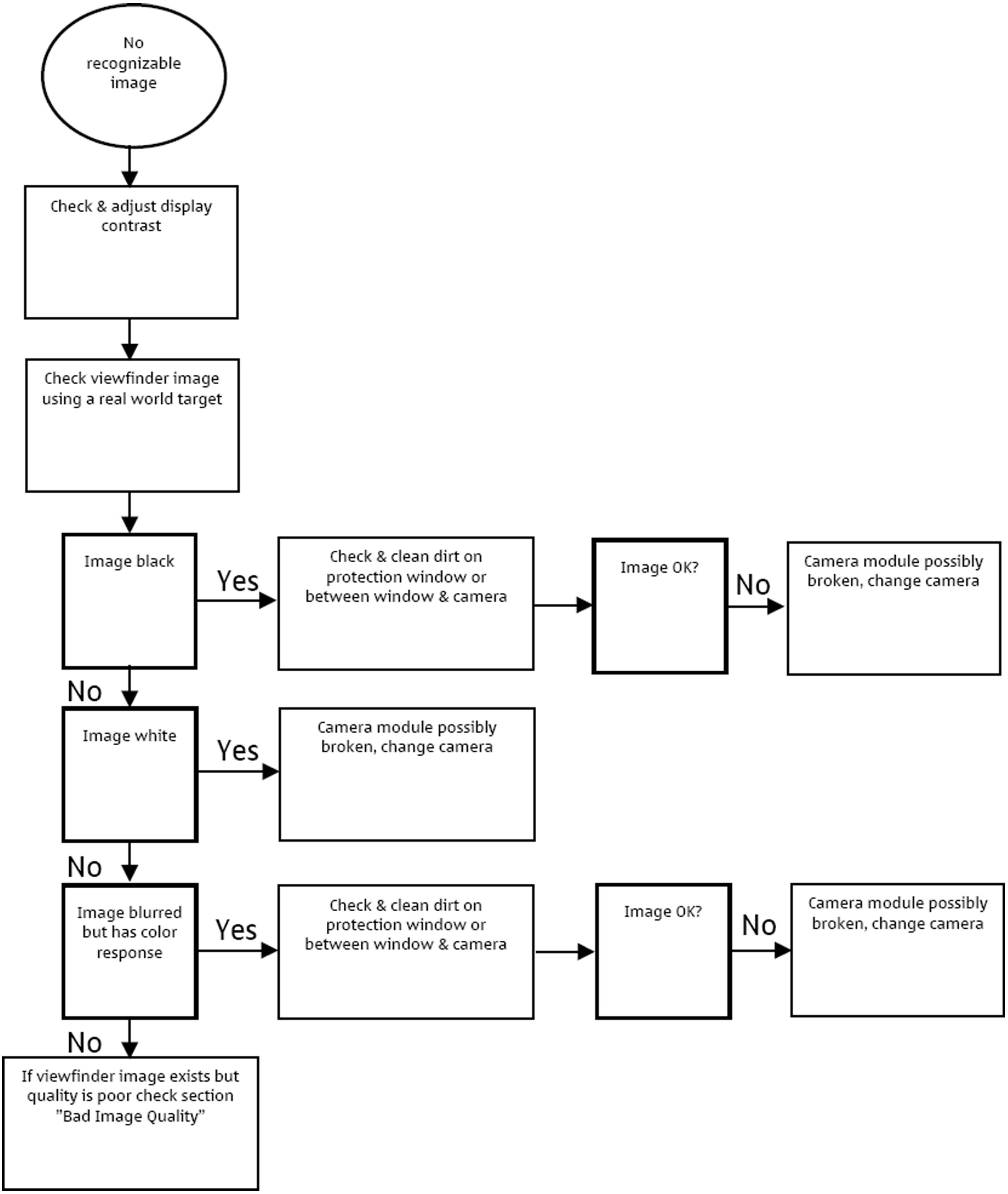
Camera hardware failure message troubleshooting

Troubleshooting flow


Start
Is Camera module properly fixed (check e.g. that connector snaps are locked, module is not slant) ?
No
Fix camera properly. Is camera working now ?
Yes
No
Yes
Remove camera using a proper removal tool. Check X3300 solder joints and spring contacts. Are those OK
No
Change X3300
Yes
Change Camera
Is the Camera working now?
No
Go to Camera baseband HW troubleshooting
Yes
End

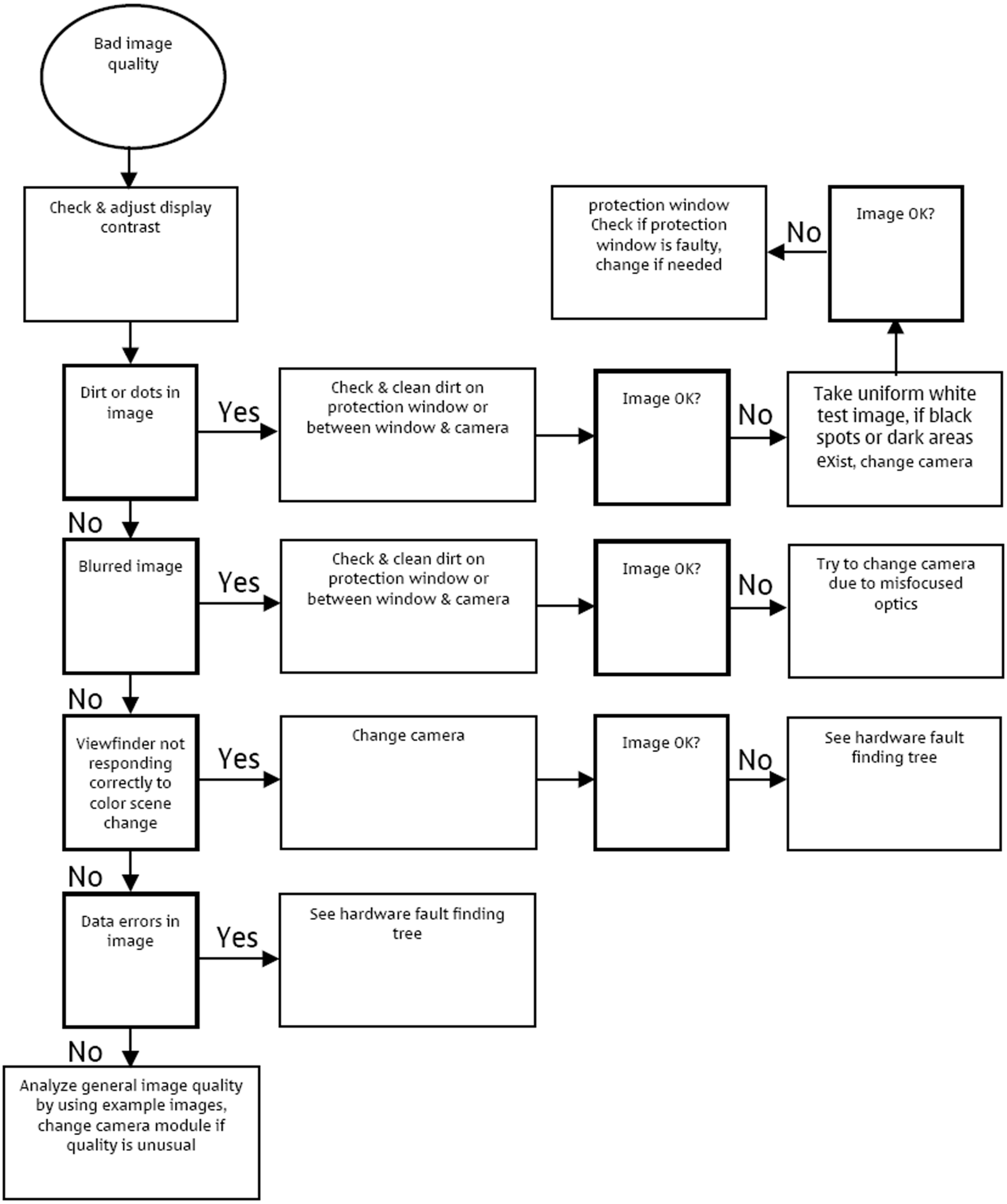
Front camera viewfinder troubleshooting

Troubleshooting flow


No recognizable image
Check & adjust display contrast
Check viewfinder image using a real world target
Image black
Yes
Check & clean dirt on protection window or between window & camera
Image OK?
No
Camera module possibly broken, change camera
No
Image white
Yes
Camera module possibly broken, change camera
No
Image blurred but has color response
Yes
Check & clean dirt on protection window or between window & camera
Image OK?
No
Camera module possibly broken, change camera
No
If viewfinder image exists but quality is poor check section "Bad Image Quality"

Front camera bad image quality troubleshooting

Troubleshooting flow


Bad image quality
Check & adjust display contrast
Dirt or dots in image
Yes
Check & clean dirt on protection window or between window & camera
Image OK?
No
Take uniform white test image, if black spots or dark areas exist, change camera
Image OK?
No
protection window Check if protection window is faulty, change if needed
No
Blurred image
Yes
Check & clean dirt on protection window or between window & camera
Image OK?
No
Try to change camera due to misfocused optics
No
Viewfinder not responding correctly to color scene change
Yes
Change camera
Image OK?
No
See hardware fault finding tree
No
Data errors in image
Yes
See hardware fault finding tree
No
Analyze general image quality by using example images, change camera module if quality is unusual

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9 — System Module

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Baseband description

System module block diagram

RM-170/171 transceiver is a S60 business voice category monoblock product. There is one system board inside the device.

Almost all components are on the backside of the Engine Module. On the top side there are key pads, joystick, earpiece pads, backup battery and display connector and their filtering components. All others are on the backside.

Note: In this description, user interface HW (UI HW) covers display, camera, keyboard and keyboard backlight.

Baseband functional description

Digital baseband consists of ISA based modem and application sections. Modem functionality is in RAP ASIC.

The modem section consists of RAP ASIC and NOR Flash and SDRAM memory as the core. NOR Flash and SDRAM memories are in one package (Combo) RAP supports cellular protocols of GSM (minimum EDGE glass 10, GPRS phase2). Modem SDRAM memory has 128Mbits of memory and NOR flash has 256Mbits of memory. RAP operates with the system clock of 38.4 MHz, which comes from the VCTCXO.

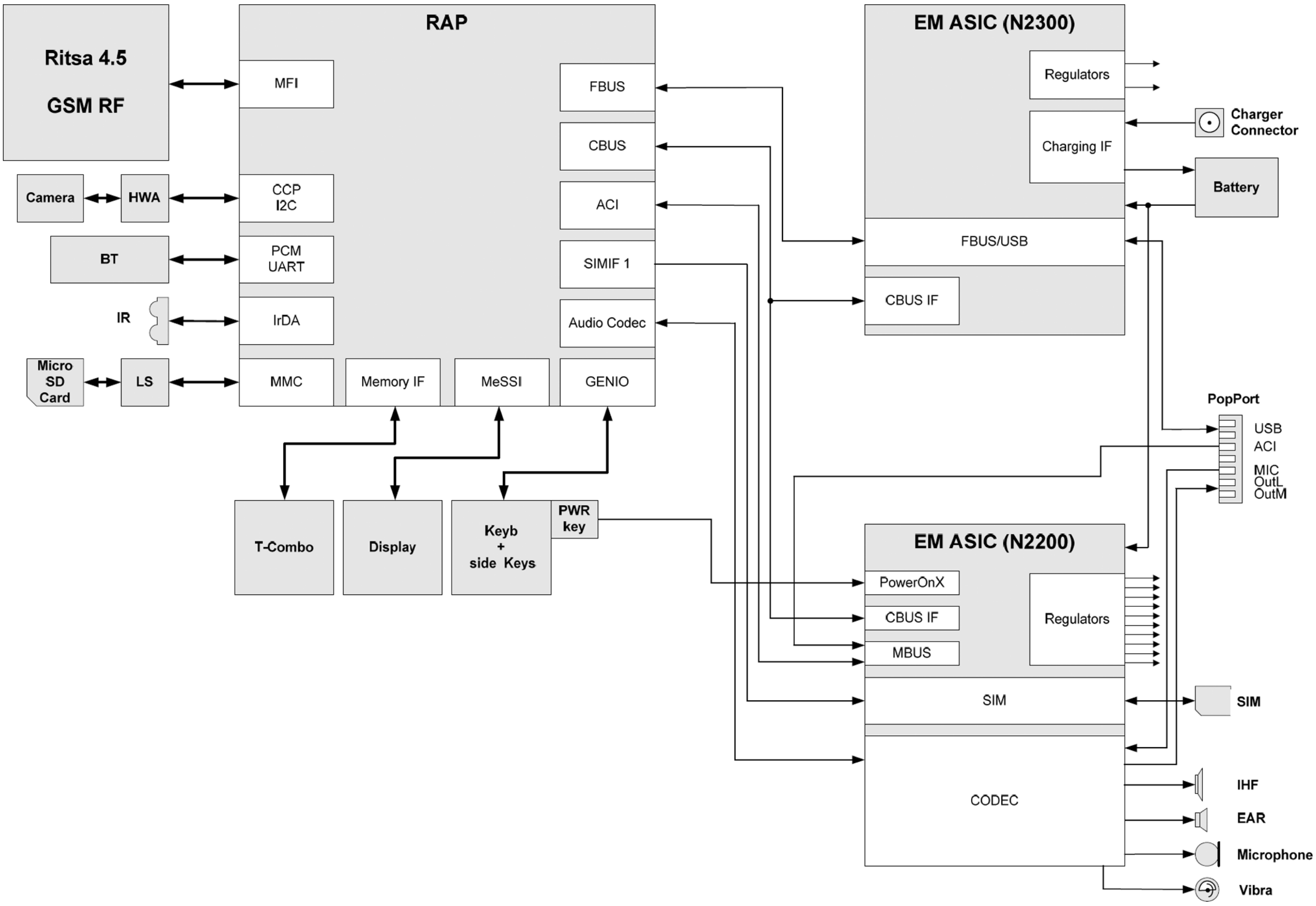

Ritsa 4.5
GSM RF
RAP
MFI
FBUS
CBUS
ACI
SIMIF 1
Audio Codec
CCP
I2C
PCM
UART
IrDA
MMC
Memory IF
MeSSI
GENIO
Camera
HWA
BT
IR
Micro
SD
Card
LS
T-Combo
Display
Keyb
+
side Keys
PWR
key
EM ASIC (N2300)
Regulators
Charging IF
Charger
Connector
Battery
FBUS/USB
CBUS IF
PopPort
USB
ACI
MIC
OutL
OutM
EM ASIC (N2200)
PowerOnX
CBUS IF
MBUS
Regulators
SIM
SIM
CODEC
IHF
EAR
Microphone
Vibra

Figure 67 RM-170/171 functional block diagram

Absolute maximum ratings

Signal	Min	Nom	Max	Unit	Notes
Battery voltage (idle)	-0.3		+4.5	V	Battery voltage maximum value is specified during charging is active
Battery voltage (Call)			+4.3	V	Battery voltage maximum value is specified during charging is active
Charger input voltage	-0.3		+16V	V	
Back-Up supply voltage	0	2.5	2.7	V	Maximum capacity of the backup power supply assumed to be 4 μAh.

Phone modes of operation

Mode	Description
NO_SUPPLY	(dead) mode means that the main battery is not present or its voltage is too low (below EM ASIC (N2200) master reset threshold) and that the back-up battery voltage is too low.
BACK_UP	The main battery is not present or its voltage is too low but back-up battery voltage is adequate and the 32kHz oscillator is running (RTC is on).
PWR_OFF	In this mode (warm), the main battery is present and its voltage is over EM ASIC (N2200) master reset threshold. All regulators are disabled, PurX is on low state, the RTC is on and the oscillator is on. PWR_OFF (cold) mode is almost the same as PWR_OFF (warm), but the RTC and the oscillator are off.
RESET	RESET mode is a synonym for start-up sequence. RESET mode uses 32kHz clock to count the REST mode delay (typically 16ms).
SLEEP	SLEEP mode is entered only from PWR_ON mode with the aid of SW when the system's activity is low.
FLASHING	FLASHING mode is for SW downloading.

Voltage limits

Parameter	Description	Value
VMSTR	Master reset threshold (EM ASIC N2200)	2.2V (typ.)
VMSTR+	Threshold for charging, rising (EM ASIC N2300)	2.1V (typ.)

Parameter	Description	Value
VMSTR-	Threshold for charging, falling (EM ASIC N2300)	1.9V (typ.)
VCOFF+	Hardware cutoff (rising)	2.9V (typ.)
VCOFF-	Hardware cutoff (falling)	2.6V (typ.)
SWCOFF	SW cutoff limit	~3.2V

Power key

The system boots up when power key is pressed (adequate battery voltage, VBAT, present).

Power down can be initiated by pressing the power key again (the system is powered down with the aid of SW). Power on key is connected to EM ASIC (N2200) ASIC via PWRONX signal.

Power distribution

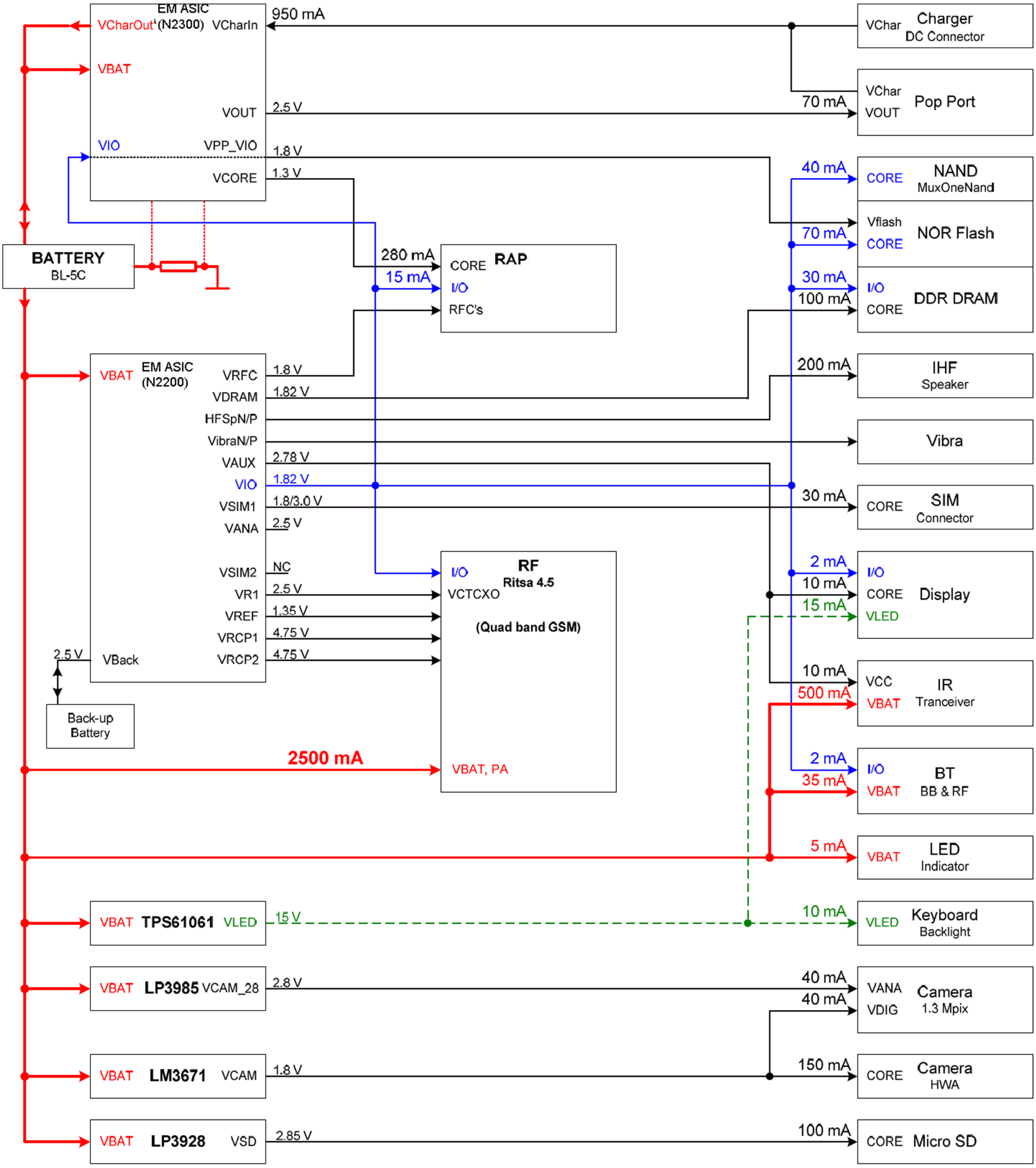

EM ASIC (N2300)
VCharOut
VCharIn
VBAT
VOUT
VIO
VPP_VIO
VCORE
950 mA
2.5 V
1.8 V
1.3 V
VChar
Charger DC Connector
VChar
VOUT
Pop Port
70 mA
40 mA
CORE
NAND MuxOneNand
Vflash
NOR Flash
70 mA
CORE
30 mA
I/O
100 mA
CORE
DDR DRAM
BATTERY BL-5C
280 mA
15 mA
CORE
RAP
I/O
RFC's
VBAT
EM ASIC (N2200)
VRFC
VDRAM
HFSpN/P
VibraN/P
VAUX
VIO
VSIM1
VANA
VSIM2
VR1
VREF
VRCP1
VRCP2
VBack
1.8 V
1.82 V
2.78 V
1.82 V
1.8/3.0 V
2.5 V
NC
2.5 V
1.35 V
4.75 V
4.75 V
2.5 V
200 mA
IHF Speaker
Vibra
30 mA
CORE
SIM Connector
I/O
RF Ritsa 4.5
VCTCXO
(Quad band GSM)
VBAT, PA
2500 mA
Back-up Battery
2 mA
10 mA
15 mA
I/O
CORE
VLED
Display
10 mA
500 mA
VCC
VBAT
IR Tranceiver
2 mA
35 mA
I/O
VBAT
BT BB & RF
5 mA
VBAT
LED Indicator
VBAT
TPS61061
VLED
15 V
10 mA
VLED
Keyboard Backlight
VBAT
LP3985
VCAM_28
2.8 V
40 mA
40 mA
VANA
VDIG
Camera 1.3 Mpix
VBAT
LM3671
VCAM
1.8 V
150 mA
CORE
Camera HWA
VBAT
LP3928
VSD
2.85 V
100 mA
CORE
Micro SD

Figure 68 Power distribution diagram

Power supply components:

- EM ASIC (N2200)
- EM ASIC (N2300)

- BT LDO
- camera LDO
- MicroSD LDO
- camera SMPS
- backlight SMPS

All the above are powered by the main battery voltage.

Battery voltage is also used on the RF side for power amplifiers (GSM PA) and for RF ASIC Ahne.

Discrete power supplies are used to generate 1.8V and 2.8V for the camera module, 2.85V for MicroSD card and max. 18V for backlight LEDs.

The device supports both 1.8V/3V SIM cards which are powered by EM ASIC (N2200) / VSIM1. EM ASIC (N2200) s VSIM2 is not used. USB accessories which needs power from the device are powered by EM ASIC (N2300) / VOUT.

Because LED driver in EM ASIC (N2300) is not used, the external SMPS is used instead. External LED SMPS is still controlled by EM ASIC (N2300) and powered by battery voltage.

System power-up

After inserting the main battery, regulators started by HW are enabled. SW checks, if there is some reason to keep the power on. If not, the system is set to power off state by watchdog. Power up can be caused by the following reasons:

- Power key is pressed
- Charger is connected
- RTC alarm occurs
- MBUS wake-up

After that:

- EM ASIC (N2200) activates sleep clock and VANA, VDRAM, VIO and VR1 regulators.
- Voltage appearing at EM ASIC (N2200)'s RSTX pin is used for enabling EM ASIC (N2300) ASIC.
- EM ASIC (N2300) enables VCORE regulator and its internal RC-oscillator (600kHz).
- VCTCXO regulator is set ON and RF clock (main system clock) is started to produce.
- EM ASIC (N2200) will release PURX ~ 16ms after power up is enabled (the RF clock is then stable enough).
- Synchronizing clock (2.4MHz) for EM ASIC (N2300) is started to be produced. After PURX is released and two rising edges of 2.4MHz synchronous clock have been detected in SMPSClk input EM ASIC (N2300) is starting to use that instead of 600kHz internal RC-oscillator.
- HW start-up procedure has been finalized and the system is up and running. Now it is possible for SW to switch ON other needed regulators.

Clocking scheme

In BB5.0, two main clocks are provided to the system: 38.4MHz RF clock produced by VCTCXO in RF section and 32.768kHz sleep clock produced by EM ASIC (N2200) with an external crystal.

RF clock is used by RAP that then provides (divided) 19.2MHz SysClk further to the application processor. RAP has internal PLLs which then create clock signals for other peripheral devices/interfaces like SD card, SIM, CCP, I2C and memories.

32k Sleep Clock is always powered on after startup. Sleep clock is used by RAP.

SMPS Clk is 2.4MHz clock line from RAP to EM ASIC (N2300) used for switch mode regulator synchronizing in active mode.

BT Clk is 38.4MHz signal from Ahne ASIC to BT module.

Bluetooth

Bluetooth provides a fully digital link for communication between a master unit and one or more slave units. The system provides a radio link that offers a high degree of flexibility to support various applications and product scenarios. Data and control interface for a low power RF module is provided. Data rate is regulated between the master and the slave.

The device Bluetooth is based on BC4 ROM1.0RDL BT chip.

USB

USB (Universal Serial Bus) provides a wired connectivity between host PC and peripheral devices.

USB is a differential serial bus for USB devices. USB controller (RAP) supports USB specification revision 2.0 with full speed USB (12 Mbps). The device is connected to the USB host through the system connector. The USB bus is hot plugged capable, which means that USB devices may be plugged in/out at any time.

Camera

The device uses SMIA85 1.3Mpix camera module. It is 1.3Mpix camera with sensor resolution to be specified. Figure 34 shows the block diagram where CCP bus is used to transfer image data from camera to the engine.

Bi-directional control bus is SW implemented I2C interface. External camera regulator (VIO level 1.8V) N3300 powers digital parts of the camera.

Digital control CAMVCTRL enables the regulator. Analog parts of the camera are powered by external regulator N3301.

CAM_ENABLE_X signal (Vctrl) is used for activating the camera module. When Vctrl is turned on High level, the camera module enters the operation mode. When Vctrl is turned on Low level, the camera module enters the power off mode. CAMCLK signal feeds system clock for camera module.

IrDA

The device supports data connectivity via the Infra Red link. The IR interface is implemented using GENIO port of RAP.

Main external component is the IR module. The data rate supported will be 1.152Mbit. The maximum operating distance of IrDA is approximately 1meter.

IR module is RPM921. It contains Rx part and TX part. Main components of Rx part are photo diode and amplifier and comparator.

Photo diode conducts when it receives IR light. signal from photo diode is amplified and compared and fed to RxD output. Tx part contains transmitter LED.

LED is controlled by TxD input. Anode of IR LED is connected directly to VBAT via 4.7 ohms current limit resistor R4490.

Supply voltage of IR module is connected to VAUX. VIO is connected to Vlogic pin and it defines I/O voltages of IR module. The shut down pin SD can power off the module.

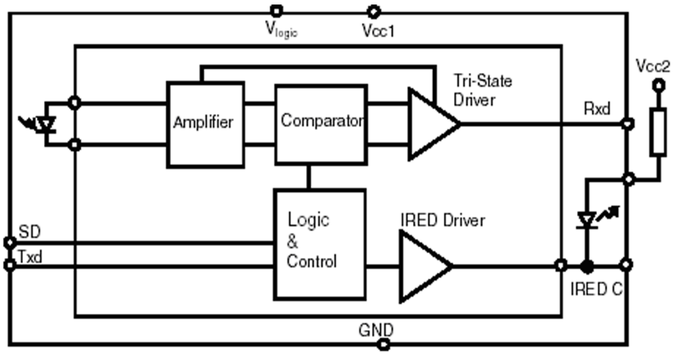


Figure 69 IR module block

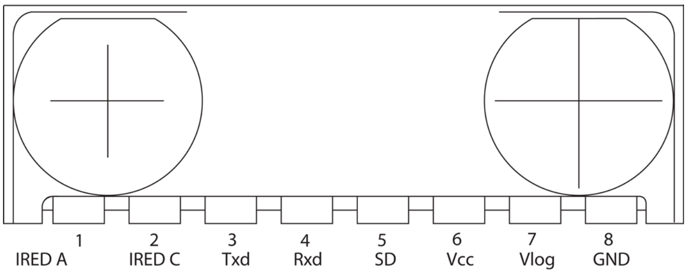


Figure 70 IR module pin ordering

Backup battery

When the main battery is not attached EM ASIC (N2200) goes in backup mode using back-up battery that supplies voltage to RTC in EM ASIC (N2200).

CBUS interface

CBUS is a "main" system control bus in BB5.0. RAP controls the functionality of EM ASIC (N2200) and EM ASIC (N2300) ASICs with CBUS.

CBUS is a four-wire half-duplex master-slave interface. In BB5.0 CBUS clock frequency is 2.4 MHz.

FBUS

USB and FBUS have multiplexed interface between EM ASIC (2300) and RAP.

ACI interface

The ACI (Accessory Control Interface) is a point-to-point, bi-directional, single line serial bus.

It has two main features: the insertion and removal detection of an accessory device and acting as a data bus between phone and accessory, intended for control purposes. A third function of ACI is to identify and authenticate the accessory.

VOUT interface

Accessory power is supplied by VOUT, a linear low drop-out regulator in EM ASIC (N2300) providing 2.5V at 90mA maximum when active (0.5mA in sleep).

ACI data passes to and from EM ASIC (N2300) via the HeadDet line. EM ASIC (N2300) connects HeadDet to MBUS for RAP to access.

Charger interface

Charging control and charge switch are situated in EM ASIC (N2300).

If the temperature rises too high and the thermal protection is activated, EM ASIC (N2300) goes to protection mode.

MicroSD interface

The MicroSD card interface is electrically and functionally compatible with SD card interface. SD card interface is a 1-bit serial IF connected to RAP.

IF includes 1.8V-2.85V level shifter and 2.85V LDO regulator (combined into one package) and an SD ASIP. Card detection is implemented by using a transistor switch connected to data3 pin of microSD card. There is an internal switch in the card reader for card insertion and removal detection. The removal detection signal is connected to GenIO47.

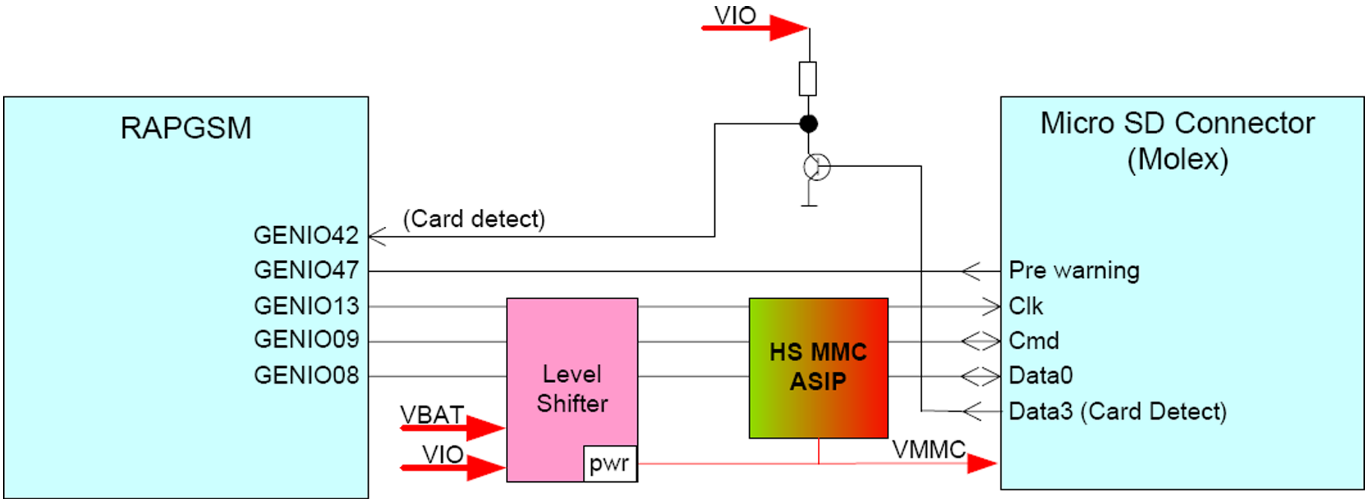
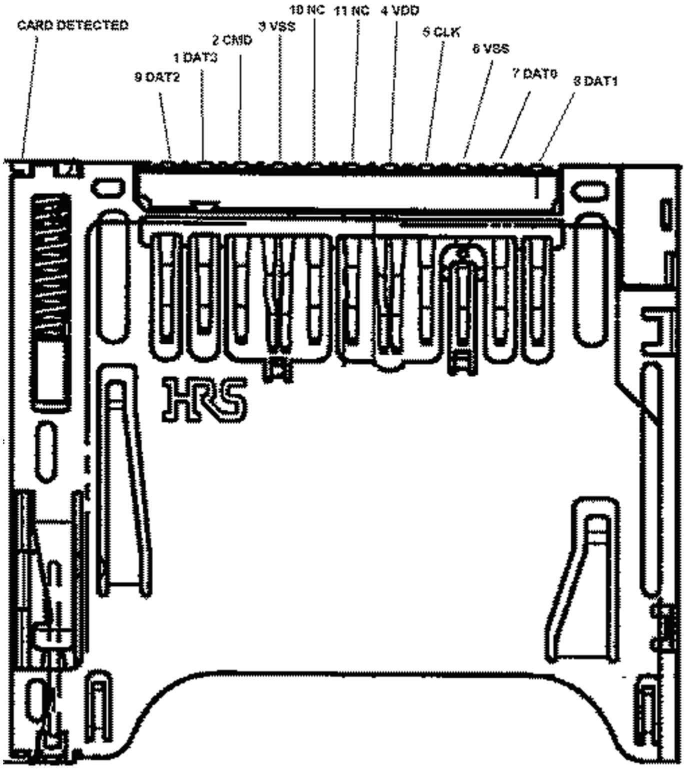

VIO
RAPGSM
GENIO42
GENIO47
GENIO13
GENIO09
GENIO08
(Card detect)
Level Shifter
pwr
VBAT
VIO
HS MMC ASIP
VMMC
Micro SD Connector (Molex)
Pre warning
Clk
Cmd
Data0
Data3 (Card Detect)

Figure 71 MicroSD interface

Table 12 MicroSD Interface

Pin	Signal	I/O	Engine connection		Notes
1	DATA2	<->	NC	NC	Reserved for future use
2	DATA3	->	RAP	GENIO42	Card detection logic
3	CMD	<->	RAP	GENIO09	Command/Response
4	VDD	<-	N3200	VMMC	VMMC supply voltage (Max 150mA)
5	CLK	<-	RAP	GENIO13	External clock for SD card, Max 19MHz
6	GND		GND		Ground
7	DATA0	<->	RAP	GENIO08	Bi-directional data bus
A	DATA1	<->	NC	NC	Reserved
9	SW	->	GND		Detection switch GND
10	DELAY	->	RAP	GENIO47	Card removal/insertion detect

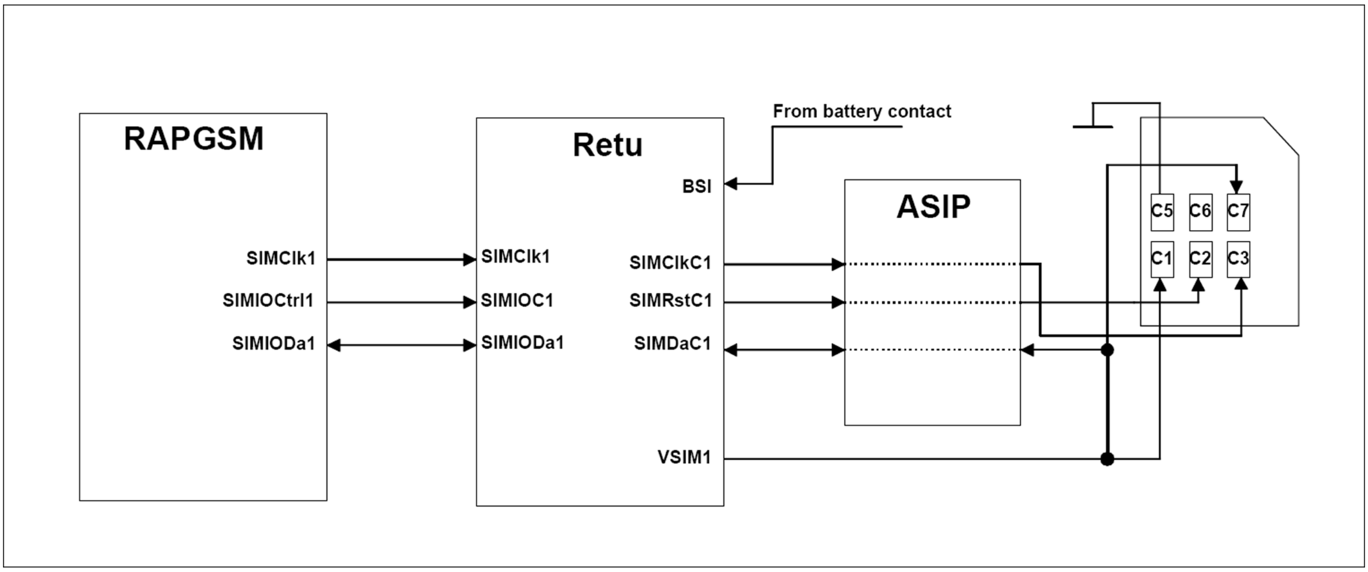

CARD DETECTED
9 DAT2
1 DAT3
2 CMD
3 VSS
10 NC
11 NC
4 VDD
5 CLK
6 VSS
7 DAT0
8 DAT1
HRS

SIM/USIM

The device has one SIM (Subscriber Identification Module) interface and the SIM card locates under the battery.

SIM interface consists of internal interface between RAP and EM ASIC (N2200) and an external interface between Retu and SIM contacts.

SIM interface functionality is located in RAP while EM ASIC (N2200) takes care of power up/down, card detection, ATR counting and level shifting. EM ASIC (N2200) external SIM IF connections and electrical characteristics between ASICs are shown in the picture.


RAPGSM
SIMClk1
SIMIOCtrl1
SIMIODa1
Retu
BSI
SIMClk1
SIMIOC1
SIMIODa1
SIMClkC1
SIMRstC1
SIMDaC1
VSIM1
From battery contact
ASIP
C5
C6
C7
C1
C2
C3

EM ASIC (N2200) handles SIM card detection and the detection method is based on battery removal trough the BSI line.

Due to location of the SIM card, removal of the battery causes quick power down of the SIM IF. The EM ASIC (N2200) SIM1 interface supports both the 1.8V and 3.0V SIM cards.

SIM interface voltage is first 1.8V when the SIM card is inserted and if the card does not response to the ATR (answer to reset) 3V interface voltage is used.

Battery interface

The battery interface supports a 3-pole battery interface. The interface consists of three connectors: VBAT, BSI and GND.

The BSI line is used to recognize the battery capacity by a battery internal pull down resistor.

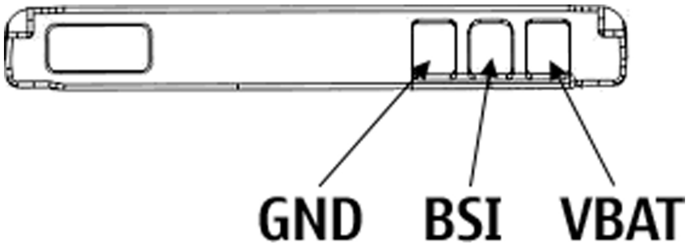


Figure 72 Battery pin order

Table 13 Battery interface connections

Pin	Signal	I/O	Engine connection		Notes
1	VBAT	->	EM ASIC N2200	VBAT	Battery voltage
2	BSI	->	EM ASIC N2200	BSI	Battery size indication (fixed resistor inside the battery pack)
3	GND		GND		Ground

Battery temperature is estimated by measuring separate battery temperature NTC via the BTEMP line, which is located on the transceiver PWB, at a place where the phone temperature is most stable.

For service purposes, the device SW can be forced into local mode by using pull down resistors connected to the BSI line.

User interface

Display interface

Display module mechanical concept

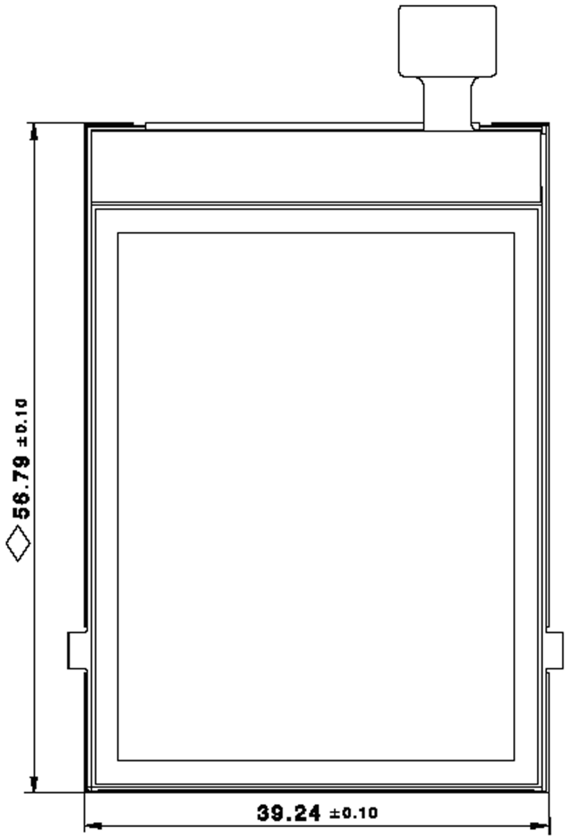


Figure 73 LCD module

Display features:

- QVGA resolution, 320x240
- Active area is x mm x y mm, 2.0"
- Partial display function Power saving by pausing display process on part of the screen.
- Built-in RAM capacity 320rows×240lines×18bit

Display is controlled via MeSSi interface by RAPGSM. All MeSSi signals are going through the EMC filtering ASIPs.

Logic power supply (1.65V-1.95V) is connected to VIO and driver power supply (2.3V – 2.9V) is connected to VAUX.

Keyboard

The device keyboard consists of 18 separate keys and four side keys.

The keymatrix has six rows and four columns. The voice key on the main PWB and the navigation key are connected to the same keymatrix.

Table 14 Keyboard matrix

	0	1	2	3	4	5	6
0	LSK	Apps	3	VolDn	VolUp	#	*
1	RSK	Send	End	1		0	Clear
2			Voice	4	2	9	Edit
3				6	8	7	5
4	Select	Down	Up	Left	Right		
5							

LSK = Left Soft key

RSK = Right Soft key

GenIO32	Row3
GenIO33	Col0
GenIO34	Col1
GenIO35	Col2
GenIO36	Row0
GenIO37	Row1
GenIO38	Col5
GenIO39	Row2
GenIO40	Col3
GenIO41	Col4
GenIO44	Row4
GenIO43	Col6

Backlights

There are two white LEDs for keyboard backlights.

The display includes four white LEDs for display backlights inside of the display module. Voltage source for backlights is implemented using an external white LED driver.

The driver increases battery voltage up to 18V. Driver is enabled by EM ASIC’s (N2300) PWM300 output. PWM300 is SW controlled pulse width modulated(PWM) output.

Display backlight current is monitored using LED driver feedback input. Keyboards backlight LEDs are connected directly to GND.

Keyboard backlight is connected directly to display backlight and cannot be separately controlled.

Indicator LED

There are two green LEDs beside navigation joystick for indication purposes. Unanswered calls, received SMS and E-mail messages are indicated by blinking these LEDs. These two LEDs are powered directly from VBAT via a switching transistor and are controlled with GENIO49.

ASICs

RAP ASIC

RAP is a GSM EDGE chip (modem ASIC) with lots of peripheral features.

The subsystems are combined at the glue level;

- processor subsystem (PSS) that includes ARM926 MCU as a main processor
- Lead3 PH3 DSP and related functions
- ASIC clock and reset control
- MCU peripherals e.g. CBUS IF, USB IF and SIM IF
- DSP peripherals e.g. speech codec
- Clock slicer. It is a block that gets low amplitude differential sinusoidal clock wave RfClkP & RfClkN 38.4MHz) in and gives an accurate square wave out (SYSCLK 19.2MHz).
- RF Codec that includes ADC and DAC converters for the RF signal

EM ASIC (N2200)

EM ASIC (N2200) includes the following functional blocks:

- Start up logic and reset control
- Charger detection
- Battery voltage monitoring
- 32.768 kHz clock with external crystal
- Real time clock with external backup battery
- SIM card interface
- Stereo audio codecs and amplifiers
- A/D converter
- Regulators
- Vibra interface
- Digital interface (CBUS)

EM ASIC (N2300)

EM ASIC (N2300) is intended for energy management control, supply voltage generation and charge control of mobile phone.

Device memories

RAP memories NOR flash, NAND flash and DDR SDRAM

Memory used in RM-170/171 consists of 256Mbit NOR flash memory, 256Mbit DDR-SDRAM and 1Gbit MuxOneNand.

DDR-SDRAM is dynamic memory for Symbian SW. NOR and NAND flashes are used as a non-volatile memory storage for Symbian SW and user data.

16-bit DDR-SDRAM interface consist of SDRAM controller from ARM and DCDL/DLLs. 16-bit muxed flash intreface is implemented by using EMC module.

DDR-SDRAM core voltage (1.8V) is generated from Retu VDRAM and I/O voltage (1.8V) from VIO. NOR and NAND flash uses VIO for both core and I/O voltages.

Actual interface speed is 58MHz for NOR flash, 117MHz for DDR-SDRAM and 39MHz for NAND flash.

Audio concept

Audio HW architecture

The functional core of the audio hardware is built around two ASICs: RAP engine ASIC and the mixed-signal EM ASIC (N2200).

EM ASIC (N2200) provides an interface for the transducers and the accessory connector. Integrated hads free speaker is driven by a D-class audio amplifier TPA2012D2.

There are three audio transducers:

- 7x11 mm dynamic earpiece
- 11x15 mm dynamic speaker
- electret microphone module

In addition to the audio transducers, EM ASIC (N2200) also provides an output for the dynamic vibra component.

Internal microphone

Internal microphone is used for HandPortable (HP) and Internal HandsFree (IHF) call modes.

An analogue electret microphone is connected to N2200 Mic1P and Mic1N inputs via asymmetric electrical connection.

The microphone is biased by N2200 MicB1 bias voltage output.

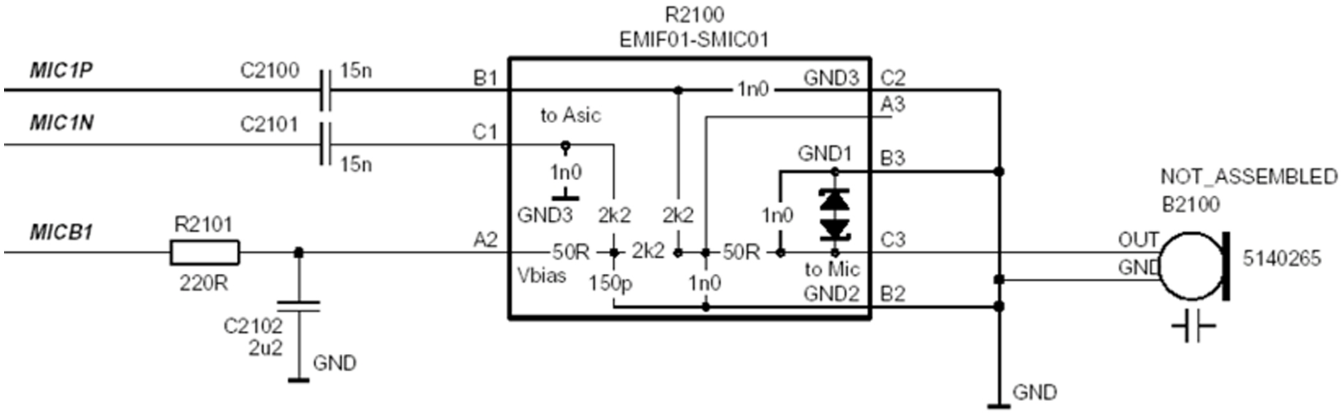

R2100
EMIF01-SMIC01
MIC1P
MIC1N
MICB1
C2100
15n
C2101
15n
R2101
220R
C2102
2u2
GND
B1
C1
A2
to Asic
1n0
GND3
2k2
2k2
50R
2k2
50R
Vbias
150p
1n0
1n0
GND3
GND1
to Mic
GND2
C2
A3
B3
C3
B2
GND
NOT_ASSEMBLED
B2100
OUT
GND
5140265

Figure 74 Internal microphone circuitry

External microphone

Galvanic accessories are connected to the system connector.

The accessory audio mode is automatically enabled/disabled during connection/disconnection of dedicated phone accessories.

External microphone circuitry is biased by N2200 MicB2 bias voltage output. The circuitry provides a symmetrical connection for the microphone from the system connector connections, XMICN and XMICP, to N2200 inputs, Mic2P and Mic2N.

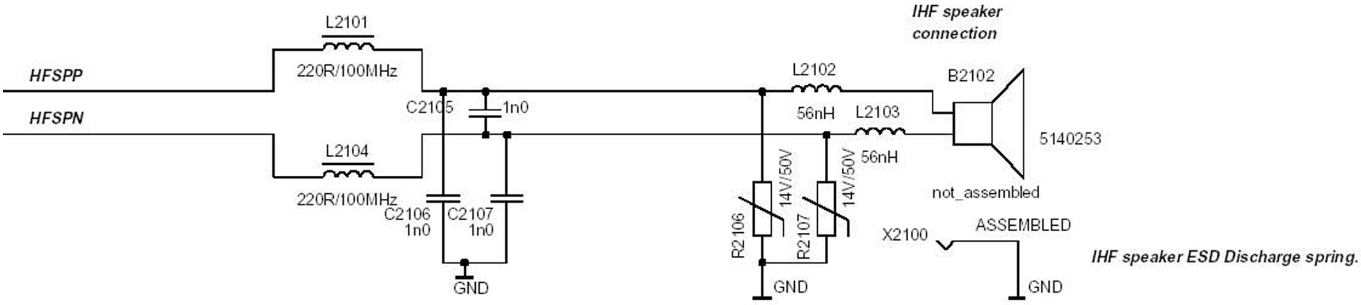

HFSPP
HFSPN
L2101
220R/100MHz
L2104
220R/100MHz
C2105
1n0
C2106
1n0
C2107
1n0
GND
IHF speaker connection
L2102
56nH
L2103
56nH
B2102
5140253
not_assembled
14V/50V
14V/50V
R2106
R2107
GND
X2100
ASSEMBLED
GND
IHF speaker ESD Discharge spring.

Figure 75 External microphone circuitry (Pop-Port™ connects to the right side)

Internal earpiece

Internal earpiece is used for the HandPortable (HP) call mode. A dynamic 8mm earpiece capsule is connected to EM ASIC’s (N2200) differential output EarP and EarN.

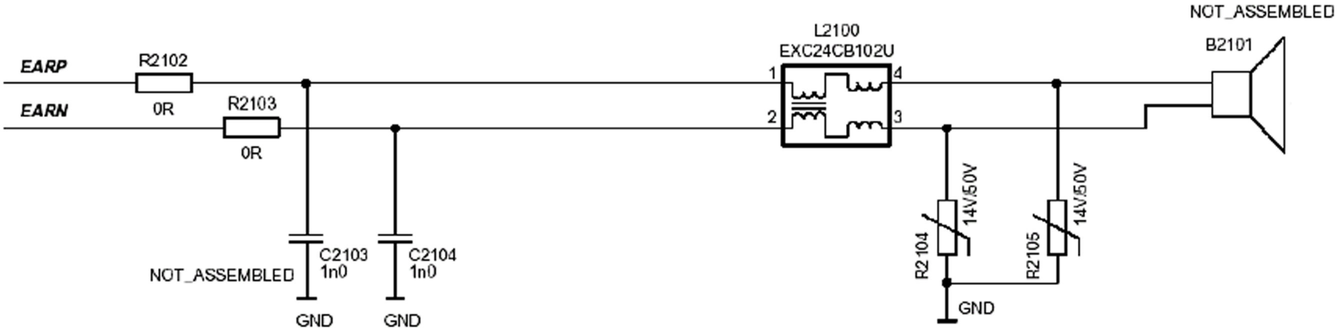

EARP
EARN
R2102
0R
R2103
0R
NOT_ASSEMBLED
C2103
1n0
C2104
1n0
GND
GND
L2100
EXC24CB102U
1
2
3
4
NOT_ASSEMBLED
B2101
14V/50V
14V/50V
R2104
R2105
GND

Figure 76 Internal earpiece circuitry

Internal speaker

Internal speakers are used for Internal HandsFree (IHF) call mode, ringing tones and music listening.

A dynamic 11x15mm speaker is connected to EM ASIC's (N2200) HFSPP and HFSPN outputs.

External earpiece

All galvanic accessories are connected to the system connector.

The accessory audio mode is automatically enabled/disabled during connection/disconnection of dedicated phone accessories.

EM ASIC (N2200) provides two output channels in either single-ended or differential format. EM ASIC (N2200) outputs XearL and XearLC form the left channel audio output, and XearR and XearRC the right channel audio output. XearLC and XearRC are the ground pins if the output works in a single-ended operation.

Xear lines have 22 Ω series resistors in each line.

In the system connector side, HSEAR P and HSEAR N form the left channel output, and HSEAR R P and HSEAR R N the right channel output. Respectively, HSEAR N and HSEAR R N are the ground pins if the output works in a single-ended operation.

Vibra circuitry

Vibra is used for vibra-alarm function.

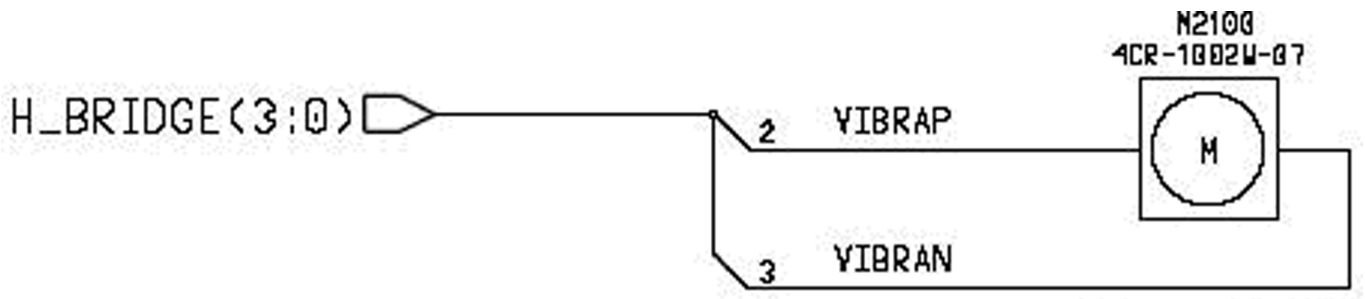


Figure 77 Vibra circuitry

Baseband technical specifications

RF-BB interfaces

Table 15 RF-BB Voltage supplies and references, interface connections and electrical characteristics

Signal	From	To	Parameter	Min	Typ	Max	Unit	Function
VBATRF	Battery	RF block	DC Voltage	3.05	3.6	5.4075	V	Battery supply voltage
								(NOTE 1)
						4.2		RF operating
GND	Battery	RF block	DC voltage		0		V	Ground
VCP1	EM ASIC (N2200)	RFIC	Voltage	4.6	4.75	4.9	V	Charge pump
	VRCP1	VCP	Current			6	mA	
			Noise density		TBD		nVrms/ÖHz	
VCP2	EM ASIC (N2200)	RFIC	Voltage	4.6	4.75	4.9	V	Charge pump
	VRCP2	VDAC	Current			6	mA	
			Noise density		TBD		nVrms/ÖHz	
VXO	EM ASIC (N2200)	VCTCXO	Voltage	2.42	2.5	Feb.58	V	Supply for reference oscillator, ref clk buffer and digital blocks of RFIC
		RFIC	Current			15	mA	
	VR1	VDIG	Noise density					
			100 Hz			400	nVrms/ÖHz	
			>300 Hz			100		

Signal	From	To	Parameter	Min	Typ	Max	Unit	Function
VREFRF01	EM ASIC (N2200)	RFIC	Voltage	1.325	1.35	1.375	V	Voltage reference for RFIC
	Vref	VBEXT	Current			100	µA	
			Noise voltage		30		µVrms	1 kHz 100 kHz
DAC_REF1	RFIC	RAP	Current	24	32	40	µA	Temp/ process dependent ref current for TXIQ DACs in RAP
	DAC_REF1	Iref1	DC voltage			1	V	
VREFCM	RFIC	RAP	Voltage	0.7	0.75	0.8	V	Reference voltages for RX ADCs in RAP
	VREFCM	VrefP						

Note: The minimum voltage is the battery voltage, which has to be available for the RF circuitry all the time during operation. The voltage drop caused by losses (PCB tracks, filtering and internal resistance of the battery) has to be added to this figure. The maximum voltage is the absolute max figure.

Digital signals

Signal	From	To	Parameter	Min	Typ	Max	Unit	Function
TXRESETX	RAP	RFIC	Logic high "1"	1.38		1.88	V	RFIC xreset
	TXReset	XRESET	Logic low "0"	0		0.4	V	
			Load resistance	10			KW	
			Load capacitance			20	pF	
			Timing accuracy			¼	symb	

Signal	From	To	Parameter	Min	Typ	Max	Unit	Function
RFBUSCLK	RAP	RFIC	Logic high "1"	1.38		1.88	V	Serial bus for RFIC control
	RFBusClk	SCLK	Logic low "0"	0		0.4	V	
			Load resistance	10			KW	
			Load capacitance			20	pF	
			Frequency		19.2		MHz	
RFBUSDAT	RAP	RFIC	See RFBusClk for parameters					
	RFBusDa	SDATA						
RFBUSENA	RAP	RFIC	See RFBusClk for parameters					
	RFBusEn1X	XENA						

Table 16 Analog signals

Signal	From	To	Parameter	Min	Typ	Max	Unit	Function
AFC	EM ASIC (N2200)	VCTCXO	Voltage min	0		0.1	V	Automatic frequency control voltage for VCTCXO
	AFC	VC	max	2.3		2.35	V	
			Load resistance		22		KW	RC Low pass filter
			Load capacitance		10		nF	
			Resolution		11		bits	
RFCLKP	RFIC	RAP	Frequency		38.4		MHz	Reference clock for base band
	REFP	RFclkP	Differential amplitude	0.5	0.8	1.6	Vpp	
			Duty cycle	-13		13	%	
			Load resistance	10			KW	
			Load capacitance			20	pF	
RFCLKN	REFN	RFclkN	See RFClkP					180° phase sift to RFClkP

Signal	From	To	Parameter	Min	Typ	Max	Unit	Function
RFCLKEXT	RFIC		Frequency		38.4		MHz	Reference clock for BT or GPS. In phase with RFClkP.
	REFG		Amplitude	0.25	0.4	0.8	Vpp	(NOTE 1)
			Duty cycle	-13		13	%	
			Load resistance	10			KW	
			Load capacitance			20	pF	
RFTEMP	RFIC	EM ASIC (N2200)	Voltage at +25°C	0.8		0.9	V	RF temperature sensor output (MUX output - used also for PA setup detection signal, GSM IQ-calibration signal)
	MUX_OUT	RFTemp	Temperature coefficient		-1.17		mV/°C	
			Temperature coefficient variation	-10		10	%	
TXC	EM ASIC (N2200)	RFIC	Voltage min	0		0.1	V	RFIC AGC control voltage
	TxC1	TXC	max	2.3		2.35		
								@200 kHz BW
			Temp variation	-12		12	mV	
			Noise density			500	uVrms	
			Load resistance		12		KW	(NOTE 2)
			Load capacitance		100		pF	
			Resolution		10		bits	

Signal	From	To	Parameter	Min	Typ	Max	Unit	Function
RXIP	RFIC	RAP	Amplitude			1.5	Vpp	Differential analog RXI signal to baseband
RXIN	RX_OUT_PI	RXIP	Common mode voltage	0.7	0.75	0.8	V	
	RX_OUT_NI	RXIN	Load impedance	1			MW	
RXQP	RFIC	RAP	See RXIP/RXIN for parameters					Differential analog RXQ signal to baseband
RXQN	RX_OUT_PQ	RXQP						
	RX_OUT_NQ	RXQN						
TXIP	RAP	RFIC	Amplitude	0		127.5	uApp	Current mode TX baseband signals
TXIN		TXI_0	Common mode current		63.75		uA	
		TXI_180	Common mode voltage	0.625		0.7	V	
TXQP	RAP	RFIC	See TXIP/TXIN for parameters					Current mode TX baseband signals
TXQN		TXQ_0						
		TXQ_180						

Note: External modules are required to include a DC-blocking capacitor in the signal line or the DC-blocking capacitor must be added outside the Rits 4.5 re-use engine area. It is recommended to use the external clock buffer between the re-use engine and the external modules.

Note: In RITSA 4 RF inside AHNE there's a RC low pass circuit of12kΩ + 100pF in the TXC line.

External interfaces

Name of Connection	Connector reference
Charger	X2002
SIM	X2700
Micro SD	X3200
Battery connector	X2070
Pop-Port™	X2000

System connector

System connector provides a fully differential 4–wire stereo line-level output connection and fully differential 2-wire mono line-level or microphone level input connection.

The handsfree driver in EM ASIC (N2200) is meant for the headset.

The output is driven in a fully differential mode. In the fully differential mode, the handsfree pin is the negative output and the HFCM pin is the positive output. The gain of the handsfree driver in the differential mode is 6 dB.

The earpiece and headset signals are multiplexed so that the outputs cannot be used simultaneously.

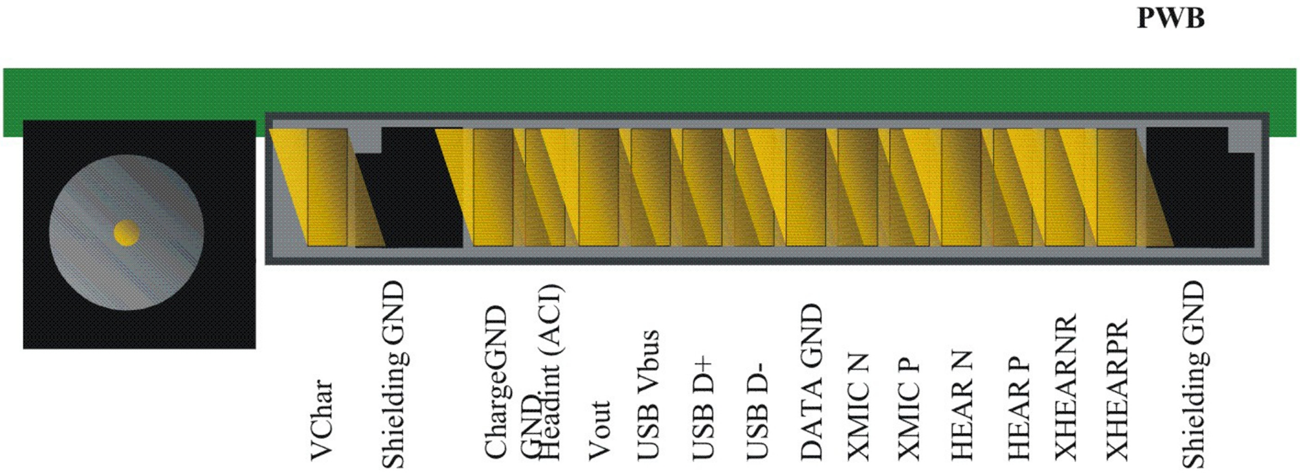

PWB
VChar
Shielding GND
ChargeGND
GND
Headint (ACI)
Vout
USB Vbus
USB D+
USB D-
DATA GND
XMIC N
XMIC P
HEAR N
HEAR P
XHEARNR
XHEARPR
Shielding GND

Figure 78 System connector

Table 17 System connector pin assignments

Pin #/ Signal name	Signal description	Spectral range	Voltage/ Current levels	Max or nominal serial impedance	Notes
1/ Charge	V Charge	DC	0-9V/ 0.85A		
2/ GND	Charge GND	-	0.85A	100mΩ (PWB+ conn.)	
3/ ACI	ACI	1kbits/s	Digital 0 / 2.5-2.78V	47Ω	Insertion & removal detection
4/ Vout	DC out	DC	2.78V 70 mA 2.5V 90mA	100mΩ (PWB+ conn.)	200mW
9 / XMIC N	Audio in	300-8k	1Vpp & 2.5-2.78VDC		
10 / XMIC P	Audio in	300-8k	1Vpp & 2.5-2.78VDC		
11 / HEAR N	Audio out	20-20k	1Vpp	22Ω	
12 / HEAR P	Audio out	20-20k	1Vpp	22Ω	
13 / HEAR R N	Audio out	20-20k	1Vpp	22Ω	Not conn. in mono
14 / HEAR R P	Audio out	20-20k	1Vpp	22Ω	Not conn. in mono

ACI interface electrical characteristics

Description	Parameter	Min	Typ	Max	Unit	Notes
Accessory detection						

Description	Parameter	Min	Typ	Max	Unit	Notes
Headset detection threshold		1.75	1.9	2.05	V	EM ASIC (N2200) specific
Headset detection hysteresis			25		mV	
Headset detection pull ups		1	2	4	uA	
After Mbus is switched to HeadDet						
High-level input voltage (VDDS = 1.8V)	V_{IH}	0.7 x V_{DDS}		V_{DDS}	V	RAP specific
Low-level input voltage	V_{IL}	0		0.3 x V_{DDS}	V	
High-level output voltage	V_{OH}	0.8 x V_{DDS}		V_{DDS}	V	
Low-level output voltage	V_{OL}	0		0.22 x VDDS	V	
Rise/fall time	tR/tF			25	ns	

VOUT electrical characteristics

Description	Parameter	Min	Max	Typical	Unit	Notes
Vout regulator for external accessories	VOUT	2.43	2.57	2.5	V	Max load 90mA

CBUS connections and electrical characteristics

CBUS connections

Pin name		I/O	Connection		Notes
RAP	CbusDa	<->	EM ASIC (N2200)	Serdata	Cbus data
			EM ASIC (N2300)	CbusData	
RAP	CbusClk	->	EM ASIC (N2200)	SerClk	Cbus clock, 2.4 MHz
			EM ASIC (N2300)	CbusClk	
RAP	CbusEn1X	->	EM ASIC (N2200)	Sersel	Cbus enable

CBUS electrical characteristics

Description	Parameter	Min	Typ	Max	Unit	Notes
High-level input voltage	VIH	0.7 x VDDS		VDDS	V	RAP specific
(VDDS = 1.8V)						
Low-level input voltage	VIL	0		0.3 x VDDS	V	
High-level output voltage	VOH	0.8 x VDDS		VDDS	V	
Low-level output voltage	VOL	0		0.22 x VDDS	V	
Frequency, CbusClk	f	1	2.4	2.5	MHz	
Rise and fall time	tR/tF					EM ASIC (N2300) specific
CLK, DaOut, EnX				6	ns	
DaIn				25	ns	

USB/FBUS connections and electrical characteristics

The USB operates in the low-power bus-mode only. The USB host provides VBUS voltage (5V, 100mA at maximum) to USB device. The USB VBUS is connected to the input of the EM ASIC (N2300) USB/FBUS regulator, which output is 3.3V in USB mode.

Headset hook detection interface (XMICN) electrical characteristics

Description	Min	Typ	Max	Unit	Notes
Hook detection threshold 1	1.25	1.35	1.45	V	Two fixed thresholds inside N2200. Selectable by SW
Hook detection threshold 2	0.5	0.6	0.7	V	
Hook detection hysteresis		25		mV	
Hook detection pull ups	1	2	4	uA	

Audio signal electrical characteristics

Description	Parameter	Typ	Unit	Notes
XMIC N	Audio in	1	V_{pp}	DC Offset 2.5-2.78V
XMIC P	Audio in	1	V_{pp}	DC Offset 2.5-2.78V
HSEAR N	Audio out	1	V_{pp}	22Ω nominal serial impedance
HSEAR P	Audio out	1	V_{pp}	22Ω nominal serial impedance
HSEAR R N	Audio out	1	V_{pp}	22Ω nominal serial impedance
				Not connected in mono
HSEAR R P	Audio out	1	V_{pp}	22Ω nominal serial impedance
				Not connected in mono

MicroSD IF electrical signal characteristics

Description	Parameter	Min	Max	Unit	Notes
MicroSD point of view					
High-level output voltage	VOH			V	IOH = ±10uA
(VMMC = 2.8V)		0.75xVMMC	VMMC+0.3		
Low-level output voltage	VOL		0.125xVMMC	V	IOL = ±10 uA
(VMMC = 2.8V)		-0.3			

Description	Parameter	Min	Max	Unit	Notes
High-level input voltage	VIH			V	IIH = ±10uA
(VMMC = 2.8V)		0.625*VMMC	VMMC+0.3		
Low-level Input voltage	VIL			V	IIL = ±10uA
(VMMC = 2.8V)		-0.3	0.25*VMMC		
RAP point of view					
High-level output voltage (VIO = 1.85V)	VOH	VIO-0.45		V	
Low-level output voltage	VOL		0.45	V	
High-level input voltage	VIH	0.65x VIO		V	
Low-level Input voltage	VIL		0.35x VIO	V	

SIM connections and electrical characteristics

Table 18 SIM IF connections

Pin	Signal	I/O	Engine connection		Notes
C1	VSIM	Out	EM ASIC (N2200)	VSIM1	Supply voltage to SIM card, 1.8V or 3.0V.
C2	SIMRST	Out	EM ASIC (N2200)	SIM1Rst	Reset signal to SIM card
C3	SIMCLK	Out	EM ASIC (N2200)	SIM1ClkC	Clock signal to SIM card
C5	GND	-	GND		Ground
C7	SIMDATA	In/Out	EM ASIC (N2200)	SIM1DaC	Data input /output

Table 19 SIM electrical characteristics

Description	Parameter	Min	Typ	Max	Unit	Notes
High-level input voltage (VDDS = 1.8V/3.0V)	VIH	0.7 x VDDS		VDDS	V	RAP specific
Low-level input voltage	VIL	0		0.3 x VDDS	V	
High-level output voltage	VOH	0.8 x VDDS		VDDS	V	

Description	Parameter	Min	Typ	Max	Unit	Notes
Low-level output voltage	VOL	0		0.22 x VDDS	V	
Frequency, SIMClk1	f	1		5	MHz	
Rise & fall time SIMClk1 SIMIOCtrl1 SIMIODa1	tR/tF			10ns 10ns 10ns		

Camera interface connections

Table 20 Camera interface connections

Pin	Signal	I/O	Engine connection		Notes
1	GND1				Ground line corresponding to VDD
2	SDA	<->	GenIO30	SDA	I2C serial control bus data
3	CCP D+	->	SpecialIO0	D+	Differential serial data, positive node
4	SCL	<-	GenIO31	SCL	I2C serial control bus clock
5	CCP D-	->	SpecialIO1	D-	Differential serial data, negative node
6	CAMCLK	<-	GenIO68	ExtClk	System clock for camera module
7	VDDI	<-	Regulator	VCAM	Camera Digital Voltage 1.8V
8	GND3				Ground line corresponding to ExtClk

Charger connector and charging interface connections & electrical characteristics

Table 21 Charging interface connections

Pin	Signal	I/O	Engine connection		Notes
1	Vchar	In	EM ASIC (N2300)	VCharIn1, 2	Charging voltage / charger detection, Center pin
2	Charge GND		Ground		Charger ground

Table 22 Charging IF electrical characteristics

Description	Parameter	Min	Max	Unit	Notes
Vchar	V Charge	0	16	V	Center pin

Description	Parameter	Min	Max	Unit	Notes
Vchar	I Charge		0.95	A	Center pin
Charge GND			0.85	A	
Threshold for charging, rising (EM ASIC (N2300))	V_{MSTR+}	2.1		V	Typical value
Threshold for charging, falling (EM ASIC (N2300))	V_{MSTR-}	1.9		V	Typical value

Battery connector and interface connections & electrical characteristics

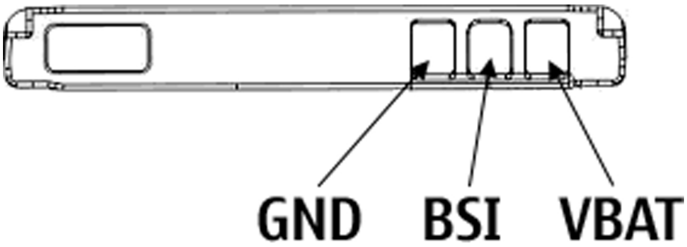


Figure 79 Battery connector

Table 23 Battery interface connections

Pin	Signal	I/O	Engine connection		Notes
1	VBAT	->	EM ASIC N2200	VBAT	Battery voltage
2	BSI	->	EM ASIC N2200	BSI	Battery size indication (fixed resistor inside the battery pack)
3	GND		GND		Ground

Table 24 Battery IF electrical characteristics

Description	Parameter	Max	Unit
Operation voltage	V_{IN}	4.23	VDC
Current rating	I_{IN}	0.9	A

Internal interfaces

Name of Connection	Connector reference	Notes
Display	X2400	
Camera	X3300	SMIA85 1.3MP

Name of Connection	Connector reference	Notes
Vibra	M2100	
Microphone	B2100	
Earpiece	B2101	
IHF speaker	B2102	

Keyboard interface electrical characteristics

Description	Parameter	Min	Typ	Max	Unit	Notes
High-level input voltage (VIO = 1.8V)	VIH	0.65x VIO	VIO	0.3+ VIODDS	V	Row
Low-level input voltage	VIL	-0.3	0	0.35x VIO	V	Row
High-level output voltage	VOH	VIO- 0.45	VIO	VIO + 0.3	V	Column
Low-level output voltage	VOL	-0.3	0	0.35xVIO	V	Column

Back-up battery interface connections and electrical characteristics

Table 25 Back-up battery connections

Pin name	I/O	Connection	Notes
VBack	->	N2200, VBack	Back-up battery G2200 is connected to N2200 via coil

Table 26 Back-up battery electrical characteristics

Description	Parameter	Min	Typ	Max	Unit
Back-Up Battery Voltage	Vback	0	2.5	2.7	V

RF description

Introduction to receiver functionality

Receiver functions are implemented in RF ASIC N7505.

The receiver is a linear direct conversion receiver consisting of separate front ends (LNA (Low Noise Amplifier) and demodulator) for each supported system. After the demodulators, the signal paths are combined to one common BB path.

GSM receiver

As GSM850, GSM900, GSM1800, GSM1900 Rx branches are functionally identical, the following description is applicable to all of them.

The received signal goes from the GSM antenna to the front end module (FEM) which includes switches from band selection. FEM is followed by dedicated SAW filters which are dual packaged so that one holds SAWs for 850 and 900 and the other for 1800 and 1900 bands. The SAW filters are followed by integrated LNAs residing in N7505.

The LNAs are followed by demodulators which downconvert the signal to baseband I and Q signals.

The channel select filter is set to 115 kHz in the GSM mode.

During a DC1 operation, a sample of the DC level of the signal is stored in off chip capacitors. During reception, information is in turn used for subtracting the DC information from the input signal of the AGC (Automatic Gain Control) amplifier.

A DCN0 operation is carried out to discharge any charge from the capacitors before DCN1.

Introduction to transmitter functionality

Transmitter functions are implemented in the RF ASIC N7505. The ASIC contains a BB frequency low pass filter, which is tunable according to the signal bandwidth of the system in use.

In addition, the N7505 contains separate RF paths comprising a final frequency IQ modulator and VGA amplifiers.

GSM transmitter

N7505 receives an analogue IQ modulated signal from digital BB, which is first low pass filtered with filter corner frequency set to approximately 200 kHz. After the filter, the signal is routed to the GSM modulator. The amplifier gives 40 dB of power control dynamic range.

The appropriate routing after the modulator is selected by biasing either EGSM900 (/GSM850) or GSM1800/1900 variable gain amplifier. The amplifier gives 40 dB of power control dynamic range.

After the VGA stage the signal exits N7505. In case of GSM1800/1900 the signal goes directly to the FEM thru a balun, which converts single ended signal into balanced signal needed to feed the FEM. In case of GSM850 and EGSM900 the PA module is preceded by a SAW filter.

TX SAW Z7503 is also dual packaged so that the correct band is selected with control voltage coming from N7505. SAW also performs the unbalanced to balanced signal transformation. After the filter, the signal is fed to FEM. Finally the signal is routed to the antenna.

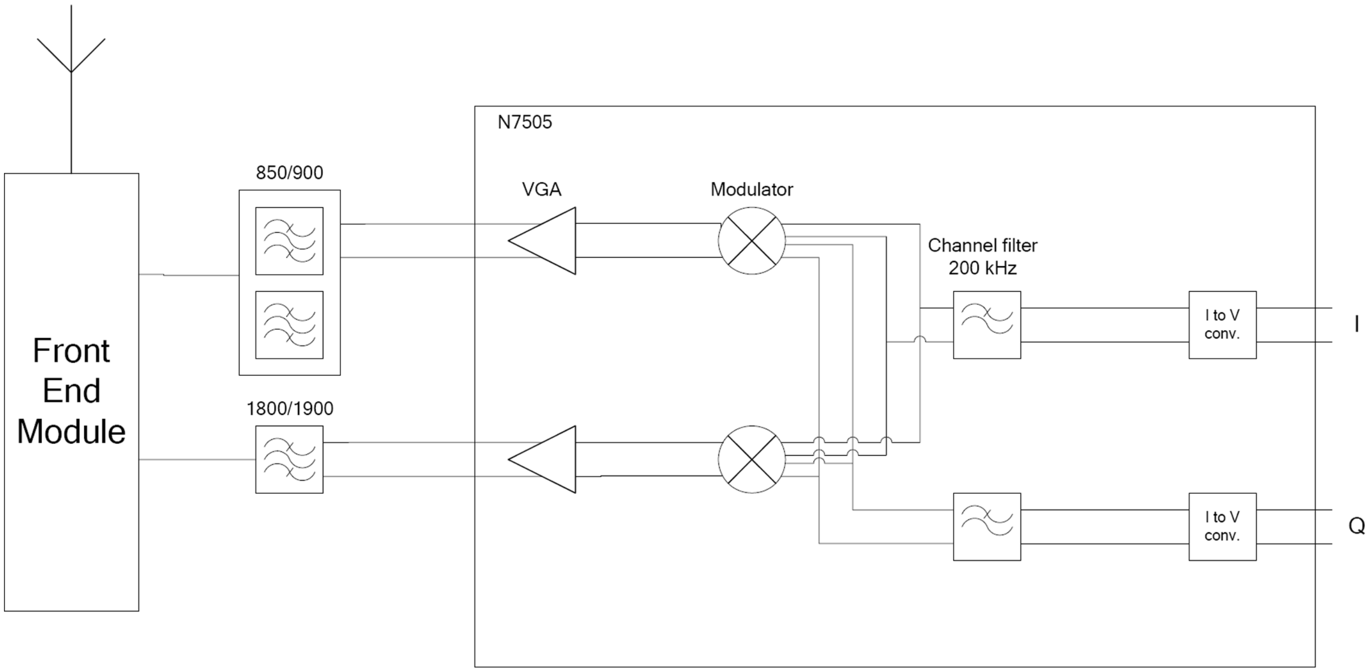


Figure 80 GSM transmitter

GSM power control

A closed control loop comprise an integrated power detector (in FEM) and an error amplifier. The error amplifier resides in N7505 and it controls the transmitter power of GSM.

Detector output from the FEM gives a DC level proportional to the output power. The DC voltage is fed to the negative input of the error amplifier where it is compared to the level of the reference signal, TXC. TXC is received from the BB circuitry.

The output of the error amplifier is fed to a buffer amplifier which in turn steers the VGA amplifier.

FEM is switched on and off by changing the bias currents. As a result the output power ramping and final power level of the transmitter are set in a controlled manner. During EDGE operation 8-PSK modulation is utilised.

The bias currents are also adjusted. The power control loop is opened during the data transmission in both GSMK and EDGE modes.

The loop is opened with a dedicated TXA-signal via RFBus. When the power is ramped up, a modulating bit sequence producing a constant envelope waveform is used and the power control loop is closed. Once the desired power level has been reached, the loop is opened and the power control voltage is kept constant.

When the active part of the burst is over the loop is again closed and the power is ramped down.

The power control loop is enabled and disabled in N7505 RF ASIC. In case of dual slot transmission the output power is ramped down between the consecutive slots.

GSM FEM (front end module)

A single GSM/EDGE FEM contains two separate amplifier chains, one for EGSM900 and GSM850 and another for GSM1800/1900.

Both amplifiers have a battery supply connection and two bias current inputs.

The bias current for final amplifier stage is adjusted according the power level in use. The bias currents are also used as on/off switching signals for PAs.

Frequency synthesizers

RF ASIC N7505 has a single synthesizer that is used to generate right frequencies for both TX and RX. The synthesizer consists of:

- PLL (Phase-Locked Loop)
- loop filter
- VCO (Voltage Controlled Oscillator)
- balun

The VCO frequencies are locked by PLLs into a reference oscillator, VCTCXO (Voltage Controlled Temperature Compensated Crystal Oscillator).

The PLLs is controlled via RFBus.

The VCOs operate at the channel frequency multiplied by two in the upper bands (for example, GSM1800/1900) and by four in EGSM900 and GSM850. The required frequency dividers required for modulators and demodulators are integrated in N7505.

Reference oscillators

A 38.4MHz VCTCXO is used as a reference oscillator for the frequency synthesizers.

Regulators

N7505 contains integrated regulators to supply regulated voltages for their internal circuitry and other RF parts.

Frequency mappings

GSM850 frequencies

CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX
128	824.2	869.2	3296.8	3476.8	170	832.6	877.6	3330.4	3510.4	212	841.0	886.0	3364.0	3544.0
129	824.4	869.4	3297.6	3477.6	171	832.8	877.8	3331.2	3511.2	213	841.2	886.2	3364.8	3544.8
130	824.6	869.6	3298.4	3478.4	172	833.0	878.0	3332.0	3512.0	214	841.4	886.4	3365.6	3545.6
131	824.8	869.8	3299.2	3479.2	173	833.2	878.2	3332.8	3512.8	215	841.6	886.6	3366.4	3546.4
132	825.0	870.0	3300.0	3480.0	174	833.4	878.4	3333.6	3513.6	216	841.8	886.8	3367.2	3547.2
133	825.2	870.2	3300.8	3480.8	175	833.6	878.6	3334.4	3514.4	217	842.0	887.0	3368.0	3548.0
134	825.4	870.4	3301.6	3481.6	176	833.8	878.8	3335.2	3515.2	218	842.2	887.2	3368.8	3548.8
135	825.6	870.6	3302.4	3482.4	177	834.0	879.0	3336.0	3516.0	219	842.4	887.4	3369.6	3549.6
136	825.8	870.8	3303.2	3483.2	178	834.2	879.2	3336.8	3516.8	220	842.6	887.6	3370.4	3550.4
137	826.0	871.0	3304.0	3484.0	179	834.4	879.4	3337.6	3517.6	221	842.8	887.8	3371.2	3551.2
138	826.2	871.2	3304.8	3484.8	180	834.6	879.6	3338.4	3518.4	222	843.0	888.0	3372.0	3552.0
139	826.4	871.4	3305.6	3485.6	181	834.8	879.8	3339.2	3519.2	223	843.2	888.2	3372.8	3552.8
140	826.6	871.6	3306.4	3486.4	182	835.0	880.0	3340.0	3520.0	224	843.4	888.4	3373.6	3553.6
141	826.8	871.8	3307.2	3487.2	183	835.2	880.2	3340.8	3520.8	225	843.6	888.6	3374.4	3554.4
142	827.0	872.0	3308.0	3488.0	184	835.4	880.4	3341.6	3521.6	226	843.8	888.8	3375.2	3555.2
143	827.2	872.2	3308.8	3488.8	185	835.6	880.6	3342.4	3522.4	227	844.0	889.0	3376.0	3556.0
144	827.4	872.4	3309.6	3489.6	186	835.8	880.8	3343.2	3523.2	228	844.2	889.2	3376.8	3556.8
145	827.6	872.6	3310.4	3490.4	187	836.0	881.0	3344.0	3524.0	229	844.4	889.4	3377.6	3557.6
146	827.8	872.8	3311.2	3491.2	188	836.2	881.2	3344.8	3524.8	230	844.6	889.6	3378.4	3558.4
147	828.0	873.0	3312.0	3492.0	189	836.4	881.4	3345.6	3525.6	231	844.8	889.8	3379.2	3559.2
148	828.2	873.2	3312.8	3492.8	190	836.6	881.6	3346.4	3526.4	232	845.0	890.0	3380.0	3560.0
149	828.4	873.4	3313.6	3493.6	191	836.8	881.8	3347.2	3527.2	233	845.2	890.2	3380.8	3560.8
150	828.6	873.6	3314.4	3494.4	192	837.0	882.0	3348.0	3528.0	234	845.4	890.4	3381.6	3561.6
151	828.8	873.8	3315.2	3495.2	193	837.2	882.2	3348.8	3528.8	235	845.6	890.6	3382.4	3562.4
152	829.0	874.0	3316.0	3496.0	194	837.4	882.4	3349.6	3529.6	236	845.8	890.8	3383.2	3563.2
153	829.2	874.2	3316.8	3496.8	195	837.6	882.6	3350.4	3530.4	237	846.0	891.0	3384.0	3564.0
154	829.4	874.4	3317.6	3497.6	196	837.8	882.8	3351.2	3531.2	238	846.2	891.2	3384.8	3564.8
155	829.6	874.6	3318.4	3498.4	197	838.0	883.0	3352.0	3532.0	239	846.4	891.4	3385.6	3565.6
156	829.8	874.8	3319.2	3499.2	198	838.2	883.2	3352.8	3532.8	240	846.6	891.6	3386.4	3566.4
157	830.0	875.0	3320.0	3500.0	199	838.4	883.4	3353.6	3533.6	241	846.8	891.8	3387.2	3567.2
158	830.2	875.2	3320.8	3500.8	200	838.6	883.6	3354.4	3534.4	242	847.0	892.0	3388.0	3568.0
159	830.4	875.4	3321.6	3501.6	201	838.8	883.8	3355.2	3535.2	243	847.2	892.2	3388.8	3568.8
160	830.6	875.6	3322.4	3502.4	202	839.0	884.0	3356.0	3536.0	244	847.4	892.4	3389.6	3569.6
161	830.8	875.8	3323.2	3503.2	203	839.2	884.2	3356.8	3536.8	245	847.6	892.6	3390.4	3570.4
162	831.0	876.0	3324.0	3504.0	204	839.4	884.4	3357.6	3537.6	246	847.8	892.8	3391.2	3571.2
163	831.2	876.2	3324.8	3504.8	205	839.6	884.6	3358.4	3538.4	247	848.0	893.0	3392.0	3572.0
164	831.4	876.4	3325.6	3505.6	206	839.8	884.8	3359.2	3539.2	248	848.2	893.2	3392.8	3572.8
165	831.6	876.6	3326.4	3506.4	207	840.0	885.0	3360.0	3540.0	249	848.4	893.4	3393.6	3573.6
166	831.8	876.8	3327.2	3507.2	208	840.2	885.2	3360.8	3540.8	250	848.6	893.6	3394.4	3574.4
167	832.0	877.0	3328.0	3508.0	209	840.4	885.4	3361.6	3541.6	251	848.8	893.8	3395.2	3575.2

EGSM900 frequencies

CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX
975	880,2	925,2	3520,8	3700,8	1	890,2	935,2	3560,8	3740,8	63	902,6	947,6	3610,4	3790,4
976	880,4	925,4	3521,6	3701,6	2	890,4	935,4	3561,6	3741,6	64	902,8	947,8	3611,2	3791,2
977	880,6	925,6	3522,4	3702,4	3	890,6	935,6	3562,4	3742,4	65	903,0	948,0	3612,0	3792,0
978	880,8	925,8	3523,2	3703,2	4	890,8	935,8	3563,2	3743,2	66	903,2	948,2	3612,8	3792,8
979	881,0	926,0	3524,0	3704,0	5	891,0	936,0	3564,0	3744,0	67	903,4	948,4	3613,6	3793,6
980	881,2	926,2	3524,8	3704,8	6	891,2	936,2	3564,8	3744,8	68	903,6	948,6	3614,4	3794,4
981	881,4	926,4	3525,6	3705,6	7	891,4	936,4	3565,6	3745,6	69	903,8	948,8	3615,2	3795,2
982	881,6	926,6	3526,4	3706,4	8	891,6	936,6	3566,4	3746,4	70	904,0	949,0	3616,0	3796,0
983	881,8	926,8	3527,2	3707,2	9	891,8	936,8	3567,2	3747,2	71	904,2	949,2	3616,8	3796,8
984	882,0	927,0	3528,0	3708,0	10	892,0	937,0	3568,0	3748,0	72	904,4	949,4	3617,6	3797,6
985	882,2	927,2	3528,8	3708,8	11	892,2	937,2	3568,8	3748,8	73	904,6	949,6	3618,4	3798,4
986	882,4	927,4	3529,6	3709,6	12	892,4	937,4	3569,6	3749,6	74	904,8	949,8	3619,2	3799,2
987	882,6	927,6	3530,4	3710,4	13	892,6	937,6	3570,4	3750,4	75	905,0	950,0	3620,0	3800,0
988	882,8	927,8	3531,2	3711,2	14	892,8	937,8	3571,2	3751,2	76	905,2	950,2	3620,8	3800,8
989	883,0	928,0	3532,0	3712,0	15	893,0	938,0	3572,0	3752,0	77	905,4	950,4	3621,6	3801,6
990	883,2	928,2	3532,8	3712,8	16	893,2	938,2	3572,8	3752,8	78	905,6	950,6	3622,4	3802,4
991	883,4	928,4	3533,6	3713,6	17	893,4	938,4	3573,6	3753,6	79	905,8	950,8	3623,2	3803,2
992	883,6	928,6	3534,4	3714,4	18	893,6	938,6	3574,4	3754,4	80	906,0	951,0	3624,0	3804,0
993	883,8	928,8	3535,2	3715,2	19	893,8	938,8	3575,2	3755,2	81	906,2	951,2	3624,8	3804,8
994	884,0	929,0	3536,0	3716,0	20	894,0	939,0	3576,0	3756,0	82	906,4	951,4	3625,6	3805,6
995	884,2	929,2	3536,8	3716,8	21	894,2	939,2	3576,8	3756,8	83	906,6	951,6	3626,4	3806,4
996	884,4	929,4	3537,6	3717,6	22	894,4	939,4	3577,6	3757,6	84	906,8	951,8	3627,2	3807,2
997	884,6	929,6	3538,4	3718,4	23	894,6	939,6	3578,4	3758,4	85	907,0	952,0	3628,0	3808,0
998	884,8	929,8	3539,2	3719,2	24	894,8	939,8	3579,2	3759,2	86	907,2	952,2	3628,8	3808,8
999	885,0	930,0	3540,0	3720,0	25	895,0	940,0	3580,0	3760,0	87	907,4	952,4	3629,6	3809,6
1000	885,2	930,2	3540,8	3720,8	26	895,2	940,2	3580,8	3760,8	88	907,6	952,6	3630,4	3810,4
1001	885,4	930,4	3541,6	3721,6	27	895,4	940,4	3581,6	3761,6	89	907,8	952,8	3631,2	3811,2
1002	885,6	930,6	3542,4	3722,4	28	895,6	940,6	3582,4	3762,4	90	908,0	953,0	3632,0	3812,0
1003	885,8	930,8	3543,2	3723,2	29	895,8	940,8	3583,2	3763,2	91	908,2	953,2	3632,8	3812,8
1004	886,0	931,0	3544,0	3724,0	30	896,0	941,0	3584,0	3764,0	92	908,4	953,4	3633,6	3813,6
1005	886,2	931,2	3544,8	3724,8	31	896,2	941,2	3584,8	3764,8	93	908,6	953,6	3634,4	3814,4
1006	886,4	931,4	3545,6	3725,6	32	896,4	941,4	3585,6	3765,6	94	908,8	953,8	3635,2	3815,2
1007	886,6	931,6	3546,4	3726,4	33	896,6	941,6	3586,4	3766,4	95	909,0	954,0	3636,0	3816,0
1008	886,8	931,8	3547,2	3727,2	34	896,8	941,8	3587,2	3767,2	96	909,2	954,2	3636,8	3816,8
1009	887,0	932,0	3548,0	3728,0	35	897,0	942,0	3588,0	3768,0	97	909,4	954,4	3637,6	3817,6
1010	887,2	932,2	3548,8	3728,8	36	897,2	942,2	3588,8	3768,8	98	909,6	954,6	3638,4	3818,4
1011	887,4	932,4	3549,6	3729,6	37	897,4	942,4	3589,6	3769,6	99	909,8	954,8	3639,2	3819,2
1012	887,6	932,6	3550,4	3730,4	38	897,6	942,6	3590,4	3770,4	100	910,0	955,0	3640,0	3820,0
1013	887,8	932,8	3551,2	3731,2	39	897,8	942,8	3591,2	3771,2	101	910,2	955,2	3640,8	3820,8
1014	888,0	933,0	3552,0	3732,0	40	898,0	943,0	3592,0	3772,0	102	910,4	955,4	3641,6	3821,6
1015	888,2	933,2	3552,8	3732,8	41	898,2	943,2	3592,8	3772,8	103	910,6	955,6	3642,4	3822,4
1016	888,4	933,4	3553,6	3733,6	42	898,4	943,4	3593,6	3773,6	104	910,8	955,8	3643,2	3823,2
1017	888,6	933,6	3554,4	3734,4	43	898,6	943,6	3594,4	3774,4	105	911,0	956,0	3644,0	3824,0
1018	888,8	933,8	3555,2	3735,2	44	898,8	943,8	3595,2	3775,2	106	911,2	956,2	3644,8	3824,8
1019	889,0	934,0	3556,0	3736,0	45	899,0	944,0	3596,0	3776,0	107	911,4	956,4	3645,6	3825,6
1020	889,2	934,2	3556,8	3736,8	46	899,2	944,2	3596,8	3776,8	108	911,6	956,6	3646,4	3826,4
1021	889,4	934,4	3557,6	3737,6	47	899,4	944,4	3597,6	3777,6	109	911,8	956,8	3647,2	3827,2
1022	889,6	934,6	3558,4	3738,4	48	899,6	944,6	3598,4	3778,4	110	912,0	957,0	3648,0	3828,0
1023	889,8	934,8	3559,2	3739,2	49	899,8	944,8	3599,2	3779,2	111	912,2	957,2	3648,8	3828,8
0	890,0	935,0	3560,0	3740,0	50	900,0	945,0	3600,0	3780,0	112	912,4	957,4	3649,6	3829,6
					51	900,2	945,2	3600,8	3780,8	113	912,6	957,6	3650,4	3830,4
					52	900,4	945,4	3601,6	3781,6	114	912,8	957,8	3651,2	3831,2
					53	900,6	945,6	3602,4	3782,4	115	913,0	958,0	3652,0	3832,0
					54	900,8	945,8	3603,2	3783,2	116	913,2	958,2	3652,8	3832,8
					55	901,0	946,0	3604,0	3784,0	117	913,4	958,4	3653,6	3833,6
					56	901,2	946,2	3604,8	3784,8	118	913,6	958,6	3654,4	3834,4
					57	901,4	946,4	3605,6	3785,6	119	913,8	958,8	3655,2	3835,2
					58	901,6	946,6	3606,4	3786,4	120	914,0	959,0	3656,0	3836,0
					59	901,8	946,8	3607,2	3787,2	121	914,2	959,2	3656,8	3836,8
					60	902,0	947,0	3608,0	3788,0	122	914,4	959,4	3657,6	3837,6
					61	902,2	947,2	3608,8	3788,8	123	914,6	959,6	3658,4	3838,4
					62	902,4	947,4	3609,6	3789,6	124	914,8	959,8	3659,2	3839,2

GSM1800 frequencies

Ch	Tx	Rx	VCO Tx	VCO Rx	Ch	Tx	Rx	VCO Tx	VCO Rx	Ch	Tx	Rx	VCO Tx	VCO Rx	Ch	Tx	Rx	VCO Tx	VCO Rx
512	1710.2	1805.2	3420.4	3610.4	606	1729.0	1824.0	3458.0	3648.0	700	1747.8	1842.8	3495.6	3685.6	793	1766.4	1861.4	3532.8	3722.8
513	1710.4	1805.4	3420.8	3610.8	607	1729.2	1824.2	3458.4	3648.4	701	1748.0	1843.0	3496.0	3686.0	794	1766.6	1861.6	3533.2	3723.2
514	1710.6	1805.6	3421.2	3611.2	608	1729.4	1824.4	3458.8	3648.8	702	1748.2	1843.2	3496.4	3686.4	795	1766.8	1861.8	3533.6	3723.6
515	1710.8	1805.8	3421.6	3611.6	609	1729.6	1824.6	3459.2	3649.2	703	1748.4	1843.4	3496.8	3686.8	796	1767.0	1862.0	3534.0	3724.0
516	1711.0	1806.0	3422.0	3612.0	610	1729.8	1824.8	3459.6	3649.6	704	1748.6	1843.6	3497.2	3687.2	797	1767.2	1862.2	3534.4	3724.4
517	1711.2	1806.2	3422.4	3612.4	611	1730.0	1825.0	3460.0	3650.0	705	1748.8	1843.8	3497.6	3687.6	798	1767.4	1862.4	3534.8	3724.8
518	1711.4	1806.4	3422.8	3612.8	612	1730.2	1825.2	3460.4	3650.4	706	1749.0	1844.0	3498.0	3688.0	799	1767.6	1862.6	3535.2	3725.2
519	1711.6	1806.6	3423.2	3613.2	613	1730.4	1825.4	3460.8	3650.8	707	1749.2	1844.2	3498.4	3688.4	800	1767.8	1862.8	3535.6	3725.6
520	1711.8	1806.8	3423.6	3613.6	614	1730.6	1825.6	3461.2	3651.2	708	1749.4	1844.4	3498.8	3688.8	801	1768.0	1863.0	3536.0	3726.0
521	1712.0	1807.0	3424.0	3614.0	615	1730.8	1825.8	3461.6	3651.6	709	1749.6	1844.6	3499.2	3689.2	802	1768.2	1863.2	3536.4	3726.4
522	1712.2	1807.2	3424.4	3614.4	616	1731.0	1826.0	3462.0	3652.0	710	1749.8	1844.8	3499.6	3689.6	803	1768.4	1863.4	3536.8	3726.8
523	1712.4	1807.4	3424.8	3614.8	617	1731.2	1826.2	3462.4	3652.4	711	1750.0	1845.0	3500.0	3690.0	804	1768.6	1863.6	3537.2	3727.2
524	1712.6	1807.6	3425.2	3615.2	618	1731.4	1826.4	3462.8	3652.8	712	1750.2	1845.2	3500.4	3690.4	805	1768.8	1863.8	3537.6	3727.6
525	1712.8	1807.8	3425.6	3615.6	619	1731.6	1826.6	3463.2	3653.2	713	1750.4	1845.4	3500.8	3690.8	806	1769.0	1864.0	3538.0	3728.0
526	1713.0	1808.0	3426.0	3616.0	620	1731.8	1826.8	3463.6	3653.6	714	1750.6	1845.6	3501.2	3691.2	807	1769.2	1864.2	3538.4	3728.4
527	1713.2	1808.2	3426.4	3616.4	621	1732.0	1827.0	3464.0	3654.0	715	1750.8	1845.8	3501.6	3691.6	808	1769.4	1864.4	3538.8	3728.8
528	1713.4	1808.4	3426.8	3616.8	622	1732.2	1827.2	3464.4	3654.4	716	1751.0	1846.0	3502.0	3692.0	809	1769.6	1864.6	3539.2	3729.2
529	1713.6	1808.6	3427.2	3617.2	623	1732.4	1827.4	3464.8	3654.8	717	1751.2	1846.2	3502.4	3692.4	810	1769.8	1864.8	3539.6	3729.6
530	1713.8	1808.8	3427.6	3617.6	624	1732.6	1827.6	3465.2	3655.2	718	1751.4	1846.4	3502.8	3692.8	811	1770.0	1865.0	3540.0	3730.0
531	1714.0	1809.0	3428.0	3618.0	625	1732.8	1827.8	3465.6	3655.6	719	1751.6	1846.6	3503.2	3693.2	812	1770.2	1865.2	3540.4	3730.4
532	1714.2	1809.2	3428.4	3618.4	626	1733.0	1828.0	3466.0	3656.0	720	1751.8	1846.8	3503.6	3693.6	813	1770.4	1865.4	3540.8	3730.8
533	1714.4	1809.4	3428.8	3618.8	627	1733.2	1828.2	3466.4	3656.4	721	1752.0	1847.0	3504.0	3694.0	814	1770.6	1865.6	3541.2	3731.2
534	1714.6	1809.6	3429.2	3619.2	628	1733.4	1828.4	3466.8	3656.8	722	1752.2	1847.2	3504.4	3694.4	815	1770.8	1865.8	3541.6	3731.6
535	1714.8	1809.8	3429.6	3619.6	629	1733.6	1828.6	3467.2	3657.2	723	1752.4	1847.4	3504.8	3694.8	816	1771.0	1866.0	3542.0	3732.0
536	1715.0	1810.0	3430.0	3620.0	630	1733.8	1828.8	3467.6	3657.6	724	1752.6	1847.6	3505.2	3695.2	817	1771.2	1866.2	3542.4	3732.4
537	1715.2	1810.2	3430.4	3620.4	631	1734.0	1829.0	3468.0	3658.0	725	1752.8	1847.8	3505.6	3695.6	818	1771.4	1866.4	3542.8	3732.8
538	1715.4	1810.4	3430.8	3620.8	632	1734.2	1829.2	3468.4	3658.4	726	1753.0	1848.0	3506.0	3696.0	819	1771.6	1866.6	3543.2	3733.2
539	1715.6	1810.6	3431.2	3621.2	633	1734.4	1829.4	3468.8	3658.8	727	1753.2	1848.2	3506.4	3696.4	820	1771.8	1866.8	3543.6	3733.6
540	1715.8	1810.8	3431.6	3621.6	634	1734.6	1829.6	3469.2	3659.2	728	1753.4	1848.4	3506.8	3696.8	821	1772.0	1867.0	3544.0	3734.0
541	1716.0	1811.0	3432.0	3622.0	635	1734.8	1829.8	3469.6	3659.6	729	1753.6	1848.6	3507.2	3697.2	822	1772.2	1867.2	3544.4	3734.4
542	1716.2	1811.2	3432.4	3622.4	636	1735.0	1830.0	3470.0	3660.0	730	1753.8	1848.8	3507.6	3697.6	823	1772.4	1867.4	3544.8	3734.8
543	1716.4	1811.4	3432.8	3622.8	637	1735.2	1830.2	3470.4	3660.4	731	1754.0	1849.0	3508.0	3698.0	824	1772.6	1867.6	3545.2	3735.2
544	1716.6	1811.6	3433.2	3623.2	638	1735.4	1830.4	3470.8	3660.8	732	1754.2	1849.2	3508.4	3698.4	825	1772.8	1867.8	3545.6	3735.6
545	1716.8	1811.8	3433.6	3623.6	639	1735.6	1830.6	3471.2	3661.2	733	1754.4	1849.4	3508.8	3698.8	826	1773.0	1868.0	3546.0	3736.0
546	1717.0	1812.0	3434.0	3624.0	640	1735.8	1830.8	3471.6	3661.6	734	1754.6	1849.6	3509.2	3699.2	827	1773.2	1868.2	3546.4	3736.4
547	1717.2	1812.2	3434.4	3624.4	641	1736.0	1831.0	3472.0	3662.0	735	1754.8	1849.8	3509.6	3699.6	828	1773.4	1868.4	3546.8	3736.8
548	1717.4	1812.4	3434.8	3624.8	642	1736.2	1831.2	3472.4	3662.4	736	1755.0	1850.0	3510.0	3700.0	829	1773.6	1868.6	3547.2	3737.2
549	1717.6	1812.6	3435.2	3625.2	643	1736.4	1831.4	3472.8	3662.8	737	1755.2	1850.2	3510.4	3700.4	830	1773.8	1868.8	3547.6	3737.6
550	1717.8	1812.8	3435.6	3625.6	644	1736.6	1831.6	3473.2	3663.2	738	1755.4	1850.4	3510.8	3700.8	831	1774.0	1869.0	3548.0	3738.0
551	1718.0	1813.0	3436.0	3626.0	645	1736.8	1831.8	3473.6	3663.6	739	1755.6	1850.6	3511.2	3701.2	832	1774.2	1869.2	3548.4	3738.4
552	1718.2	1813.2	3436.4	3626.4	646	1737.0	1832.0	3474.0	3664.0	740	1755.8	1850.8	3511.6	3701.6	833	1774.4	1869.4	3548.8	3738.8
553	1718.4	1813.4	3436.8	3626.8	647	1737.2	1832.2	3474.4	3664.4	741	1756.0	1851.0	3512.0	3702.0	834	1774.6	1869.6	3549.2	3739.2
554	1718.6	1813.6	3437.2	3627.2	648	1737.4	1832.4	3474.8	3664.8	742	1756.2	1851.2	3512.4	3702.4	835	1774.8	1869.8	3549.6	3739.6
555	1718.8	1813.8	3437.6	3627.6	649	1737.6	1832.6	3475.2	3665.2	743	1756.4	1851.4	3512.8	3702.8	836	1775.0	1870.0	3550.0	3740.0
556	1719.0	1814.0	3438.0	3628.0	650	1737.8	1832.8	3475.6	3665.6	744	1756.6	1851.6	3513.2	3703.2	837	1775.2	1870.2	3550.4	3740.4
557	1719.2	1814.2	3438.4	3628.4	651	1738.0	1833.0	3476.0	3666.0	745	1756.8	1851.8	3513.6	3703.6	838	1775.4	1870.4	3550.8	3740.8
558	1719.4	1814.4	3438.8	3628.8	652	1738.2	1833.2	3476.4	3666.4	746	1757.0	1852.0	3514.0	3704.0	839	1775.6	1870.6	3551.2	3741.2
559	1719.6	1814.6	3439.2	3629.2	653	1738.4	1833.4	3476.8	3666.8	747	1757.2	1852.2	3514.4	3704.4	840	1775.8	1870.8	3551.6	3741.6
560	1719.8	1814.8	3439.6	3629.6	654	1738.6	1833.6	3477.2	3667.2	748	1757.4	1852.4	3514.8	3704.8	841	1776.0	1871.0	3552.0	3742.0
561	1720.0	1815.0	3440.0	3630.0	655	1738.8	1833.8	3477.6	3667.6	749	1757.6	1852.6	3515.2	3705.2	842	1776.2	1871.2	3552.4	3742.4
562	1720.2	1815.2	3440.4	3630.4	656	1739.0	1834.0	3478.0	3668.0	750	1757.8	1852.8	3515.6	3705.6	843	1776.4	1871.4	3552.8	3742.8
563	1720.4	1815.4	3440.8	3630.8	657	1739.2	1834.2	3478.4	3668.4	751	1758.0	1853.0	3516.0	3706.0	844	1776.6	1871.6	3553.2	3743.2
564	1720.6	1815.6	3441.2	3631.2	658	1739.4	1834.4	3478.8	3668.8	752	1758.2	1853.2	3516.4	3706.4	845	1776.8	1871.8	3553.6	3743.6
565	1720.8	1815.8	3441.6	3631.6	659	1739.6	1834.6	3479.2	3669.2	753	1758.4	1853.4	3516.8	3706.8	846	1777.0	1872.0	3554.0	3744.0
566	1721.0	1816.0	3442.0	3632.0	660	1739.8	1834.8	3479.6	3669.6	754	1758.6	1853.6	3517.2	3707.2	847	1777.2	1872.2	3554.4	3744.4
567	1721.2	1816.2	3442.4	3632.4	661	1740.0	1835.0	3480.0	3670.0	755	1758.8	1853.8	3517.6	3707.6	848	1777.4	1872.4	3554.8	3744.8
568	1721.4	1816.4	3442.8	3632.8	662	1740.2	1835.2	3480.4	3670.4	756	1759.0	1854.0	3518.0	3708.0	849	1777.6	1872.6	3555.2	3745.2
569	1721.6	1816.6	3443.2	3633.2	663	1740.4	1835.4	3480.8	3670.8	757	1759.2	1854.2	3518.4	3708.4	850	1777.8	1872.8	3555.6	3745.6
570	1721.8	1816.8	3443.6	3633.6	664	1740.6	1835.6	3481.2	3671.2	758	1759.4	1854.4	3518.8	3708.8	851	1778.0	1873.0	3556.0	3746.0
571	1722.0	1817.0	3444.0	3634.0	665	1740.8	1835.8	3481.6	3671.6	759	1759.6	1854.6	3519.2	3709.2	852	1778.2	1873.2	3556.4	3746.4
572	1722.2	1817.2	3444.4	3634.4	666	1741.0	1836.0	3482.0	3672.0	760	1759.8	1854.8	3519.6	3709.6	853	1778.4	1873.4	3556.8	3746.8
573	1722.4	1817.4	3444.8	3634.8	667	1741.2	1836.2	3482.4	3672.4	761	1760.0	1855.0	3520.0	3710.0	854	1778.6	1873.6	3557.2	3747.2
574	1722.6	1817.6	3445.2	3635.2	668	1741.4	1836.4	3482.8	3672.8	762	1760.2	1855.2	3520.4	3710.4	855	1778.8	1873.8	3557.6	3747.6
575	1722.8	1817.8	3445.6	3635.6	669	1741.6	1836.6	3483.2	3673.2	763	1760.4	1855.4	3520.8	3710.8	856	1779.0	1874.0	3558.0	3748.0
576	1723.0	1818.0	3446.0	3636.0	670	1741.8	1836.8	3483.6	3673.6	764	1760.6	1855.6	3521.2	3711.2	857	1779.2	1874.2	3558.4	3748.4
577	1723.2	1818.2	3446.4	3636.4	671	1742.0	1837.0	3484.0	3674.0	765	1760.8	1855.8	3521.6	3711.6	858	1779.4	1874.4	3558.8	3748.8
578	1723.4	1818.4	3446.8	3636.8	672	1742.2	1837.2	3484.4	3674.4	766	1761.0	1856.0	3522.0	3712.0	859	1779.6	1874.6	3559.2	3749.2
579	1723.6	1818.6	3447.2	3637.2	673	1742.4	1837.4	3484.8	3674.8	767	1761.2	1856.2	3522.4	3712.4	860	1779.8	1874.8	3559.6	3749.6
580	1723.8	1818.8	3447.6	3637.6	674	1742.6	1837.6	3485.2	3675.2	768	1761.4	1856.4	3522.8	3712.8	861	1780.0	1875.0	3560.0	3750.0
581	1724.0	1819.0	3448.0	3638.0	675	1742.8	1837.8	3485.6	3675.6	769	1761.6	1856.6	3523.2	3713.2	862	1780.2	1875.2	3560.4	3750.4
582	1724.2	1819.2	3448.4	3638.4	676	1743.0	1838.0	3486.0	3676.0	770	1761.8	1856.8	3523.6	3713.6	863	1780.4	1875.4	3560.8	3750.8
583	1724.4	1819.4	3448.8	3638.8	677	1743.2	1838.2	3486.4	3676.4	771	1762.0	1857.0	3524.0	3714.0	864	1780.6	1875.6	3561.2	3751.2
584	1724.6	1819.6	3449.2	3639.2	678	1743.4	1838.4	3486.8	3676.8	772	1762.2	1857.2	3524.4	3714.4	865	1780.8	1875.8	3561.6	3751.6
585	1724.8	1819.8	3449.6	3639.6	679	1743.6	1838.6	3487.2	3677.2	773	1762.4	1857.4	3524.8	3714.8	866	1781.0	1876.0	3562.0	3752.0
586	1725.0	1820.0	3450.0	3640.0	680	1743.8	1838.8	3487.6	3677.6	774	1762.6	1857.6	3525.2	3715.2	867	1781.2	1876.2	3562.4	3752.4
587	1725.2	1820.2	3450.4	3640.4	681	1744.0	1839.0	3488.0	3678.0	775	1762.8	1857.8	3525.6	3715.6	868	1781.4	1876.4	3562.8	3752.8
588	1725.4	1820.4	3450.8	3640.8	682	1744.2	1839.2	3488.4	3678.4	776	1763.0	1858.0	3526.0	3716.0	869	1781.6	1876.6	3563.2	3753.2
589	1725.6	1820.6	3451.2	3641.2	683	1744.4	1839.4	3488.8	3678.8	777	1763.2	1858.2	3526.4	3716.4	870	1781.8	1876.8	3563.6	3753.6
590	1725.8	1820.8	3451.6	3641.6	684	1744.6	1839.6	3489.2	3679.2	778	1763.4	1858.4	3526.8	3716.8	871	1782.0	1877.0	3564.0	3754.0
591	1726.0	1821.0	3452.0	3642.0	685	1744.8	1839.8	3489.6	3679.6	779	1763.6	1858.6	3527.2	3717.2	872	1782.2	1877.2	3564.4	3754.4
592	1726.2	1821.2	3452.4	3642.4	686	1745.0	1840.0	3490.0	3680.0	780	1763.8	1858.8	3527.6	3717.6	873	1782.4	1877.4	3564.8	3754.8
593	1726.4	1821.4	3452.8	3642.8	687	1745.2	1840.2	3490.4	3680.4	781	1764.0	1859.0	3528.0	3718.0	874	1782.6	1877.6	3565.2	3755.2
594	1726.6	1821.6	3453.2	3643.2	688	1745.4	1840.4	3490.8	3680.8	782	1764.2	1859.2	3528.4	3718.4	875	1782.8	1877.8	3565.6	3755.6
595	1726.8	1821.8	3453.6	3643.6	689	1745.6	1840.6	3491.2	3681.2	783	1764.4	1859.4	3528.8	3718.8	876	1783.0	1878.0	3566.0	3756.0
596	1727.0	1822.0	3454.0	3644.0	690	1745.8	1840.8	3491.6	3681.6	784	1764.6	1859.6	3529.2	3719.2	877	1783.2	1878.2	3566.4	3756.4
597	1727.2	1822.2	3454.4	3644.4	691	1746.0	1841.0	3492.0	3682.0	785	1764.8	1859.8	3529.6	3719.6	878	1783.4	1878.4	3566.8	3756.8
598	1727.4	1822.4	3454.8	3644.8	692	1746.2	1841.2	3492.4	3682.4	786	1765.0	1860.0	3530.0	3720.0	879	1783.6	1878.6	3567.2	3757.2
599	1727.6	1822.6	3455.2	3645.2	693	1746.4	1841.4	3492.8	3682.8	787	1765.2	1860.2	3530.4	3720.4	880	1783.8	1878.8	3567.6	3757.6
600	1727.8	1822.8	3455.6	3645.6	694	1746.6	1841.6	3493.2	3683.2	788	1765.4	1860.4	3530.8	3720.8	881	1784.0	1879.0	3568.0	3758.0
601	1728.0	1823.0	3456.0	3646.0	695	1746.8	1841.8	3493.6	3683.6	789	1765.6	1860.6	3531.2	3721.2	882	1784.2	1879.2	3568.4	3758.4
602	1728.2	1823.2	3456.4	3646.4	696	1747.0	1842.0	3494.0	3684.0	790	1765.8	1860.8	3531.6	3721.6	883	1784.4	1879.4	3568.8	3758.8
603	1728.4	1823.4	3456.8	3646.8	697	1747.2	1842.2	3494.4	3684.4	791	1766.0	1861.0	3532.0	3722.0	884	1784.6	1879.6	3569.2	3759.2
604	1728.6	1823.6	3457.2	3647.2	698	1747.4	1842.4	3494.8	3684.8	792	1766.2	1861.2	3532.4	3722.4	885	1784.8	1879.8	3569.6	3759.6
605	1728.8	1823.8	3457.6	3647.6	699	1747.6	1842.6	3495.2	3685.2										

GSM1900 frequencies

CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX
512	1850,2	1930,2	3700,4	3860,4	606	1869,0	1949,0	3738,0	3898,0	700	1887,8	1967,8	3775,6	3935,6	794	1906,6	1986,6	3813,2	3973,2
513	1850,4	1930,4	3700,8	3860,8	607	1869,2	1949,2	3738,4	3898,4	701	1888,0	1968,0	3776,0	3936,0	795	1906,8	1986,8	3813,6	3973,6
514	1850,6	1930,6	3701,2	3861,2	608	1869,4	1949,4	3738,8	3898,8	702	1888,2	1968,2	3776,4	3936,4	796	1907,0	1987,0	3814,0	3974,0
515	1850,8	1930,8	3701,6	3861,6	609	1869,6	1949,6	3739,2	3899,2	703	1888,4	1968,4	3776,8	3936,8	797	1907,2	1987,2	3814,4	3974,4
516	1851,0	1931,0	3702,0	3862,0	610	1869,8	1949,8	3739,6	3899,6	704	1888,6	1968,6	3777,2	3937,2	798	1907,4	1987,4	3814,8	3974,8
517	1851,2	1931,2	3702,4	3862,4	611	1870,0	1950,0	3740,0	3900,0	705	1888,8	1968,8	3777,6	3937,6	799	1907,6	1987,6	3815,2	3975,2
518	1851,4	1931,4	3702,8	3862,8	612	1870,2	1950,2	3740,4	3900,4	706	1889,0	1969,0	3778,0	3938,0	800	1907,8	1987,8	3815,6	3975,6
519	1851,6	1931,6	3703,2	3863,2	613	1870,4	1950,4	3740,8	3900,8	707	1889,2	1969,2	3778,4	3938,4	801	1908,0	1988,0	3816,0	3976,0
520	1851,8	1931,8	3703,6	3863,6	614	1870,6	1950,6	3741,2	3901,2	708	1889,4	1969,4	3778,8	3938,8	802	1908,2	1988,2	3816,4	3976,4
521	1852,0	1932,0	3704,0	3864,0	615	1870,8	1950,8	3741,6	3901,6	709	1889,6	1969,6	3779,2	3939,2	803	1908,4	1988,4	3816,8	3976,8
522	1852,2	1932,2	3704,4	3864,4	616	1871,0	1951,0	3742,0	3902,0	710	1889,8	1969,8	3779,6	3939,6	804	1908,6	1988,6	3817,2	3977,2
523	1852,4	1932,4	3704,8	3864,8	617	1871,2	1951,2	3742,4	3902,4	711	1890,0	1970,0	3780,0	3940,0	805	1908,8	1988,8	3817,6	3977,6
524	1852,6	1932,6	3705,2	3865,2	618	1871,4	1951,4	3742,8	3902,8	712	1890,2	1970,2	3780,4	3940,4	806	1909,0	1989,0	3818,0	3978,0
525	1852,8	1932,8	3705,6	3865,6	619	1871,6	1951,6	3743,2	3903,2	713	1890,4	1970,4	3780,8	3940,8	807	1909,2	1989,2	3818,4	3978,4
526	1853,0	1933,0	3706,0	3866,0	620	1871,8	1951,8	3743,6	3903,6	714	1890,6	1970,6	3781,2	3941,2	808	1909,4	1989,4	3818,8	3978,8
527	1853,2	1933,2	3706,4	3866,4	621	1872,0	1952,0	3744,0	3904,0	715	1890,8	1970,8	3781,6	3941,6	809	1909,6	1989,6	3819,2	3979,2
528	1853,4	1933,4	3706,8	3866,8	622	1872,2	1952,2	3744,4	3904,4	716	1891,0	1971,0	3782,0	3942,0	810	1909,8	1989,8	3819,6	3979,6
529	1853,6	1933,6	3707,2	3867,2	623	1872,4	1952,4	3744,8	3904,8	717	1891,2	1971,2	3782,4	3942,4					
530	1853,8	1933,8	3707,6	3867,6	624	1872,6	1952,6	3745,2	3905,2	718	1891,4	1971,4	3782,8	3942,8					
531	1854,0	1934,0	3708,0	3868,0	625	1872,8	1952,8	3745,6	3905,6	719	1891,6	1971,6	3783,2	3943,2					
532	1854,2	1934,2	3708,4	3868,4	626	1873,0	1953,0	3746,0	3906,0	720	1891,8	1971,8	3783,6	3943,6					
533	1854,4	1934,4	3708,8	3868,8	627	1873,2	1953,2	3746,4	3906,4	721	1892,0	1972,0	3784,0	3944,0					
534	1854,6	1934,6	3709,2	3869,2	628	1873,4	1953,4	3746,8	3906,8	722	1892,2	1972,2	3784,4	3944,4					
535	1854,8	1934,8	3709,6	3869,6	629	1873,6	1953,6	3747,2	3907,2	723	1892,4	1972,4	3784,8	3944,8					
536	1855,0	1935,0	3710,0	3870,0	630	1873,8	1953,8	3747,6	3907,6	724	1892,6	1972,6	3785,2	3945,2					
537	1855,2	1935,2	3710,4	3870,4	631	1874,0	1954,0	3748,0	3908,0	725	1892,8	1972,8	3785,6	3945,6					
538	1855,4	1935,4	3710,8	3870,8	632	1874,2	1954,2	3748,4	3908,4	726	1893,0	1973,0	3786,0	3946,0					
539	1855,6	1935,6	3711,2	3871,2	633	1874,4	1954,4	3748,8	3908,8	727	1893,2	1973,2	3786,4	3946,4					
540	1855,8	1935,8	3711,6	3871,6	634	1874,6	1954,6	3749,2	3909,2	728	1893,4	1973,4	3786,8	3946,8					
541	1856,0	1936,0	3712,0	3872,0	635	1874,8	1954,8	3749,6	3909,6	729	1893,6	1973,6	3787,2	3947,2					
542	1856,2	1936,2	3712,4	3872,4	636	1875,0	1955,0	3750,0	3910,0	730	1893,8	1973,8	3787,6	3947,6					
543	1856,4	1936,4	3712,8	3872,8	637	1875,2	1955,2	3750,4	3910,4	731	1894,0	1974,0	3788,0	3948,0					
544	1856,6	1936,6	3713,2	3873,2	638	1875,4	1955,4	3750,8	3910,8	732	1894,2	1974,2	3788,4	3948,4					
545	1856,8	1936,8	3713,6	3873,6	639	1875,6	1955,6	3751,2	3911,2	733	1894,4	1974,4	3788,8	3948,8					
546	1857,0	1937,0	3714,0	3874,0	640	1875,8	1955,8	3751,6	3911,6	734	1894,6	1974,6	3789,2	3949,2					
547	1857,2	1937,2	3714,4	3874,4	641	1876,0	1956,0	3752,0	3912,0	735	1894,8	1974,8	3789,6	3949,6					
548	1857,4	1937,4	3714,8	3874,8	642	1876,2	1956,2	3752,4	3912,4	736	1895,0	1975,0	3790,0	3950,0					
549	1857,6	1937,6	3715,2	3875,2	643	1876,4	1956,4	3752,8	3912,8	737	1895,2	1975,2	3790,4	3950,4					
550	1857,8	1937,8	3715,6	3875,6	644	1876,6	1956,6	3753,2	3913,2	738	1895,4	1975,4	3790,8	3950,8					
551	1858,0	1938,0	3716,0	3876,0	645	1876,8	1956,8	3753,6	3913,6	739	1895,6	1975,6	3791,2	3951,2					
552	1858,2	1938,2	3716,4	3876,4	646	1877,0	1957,0	3754,0	3914,0	740	1895,8	1975,8	3791,6	3951,6					
553	1858,4	1938,4	3716,8	3876,8	647	1877,2	1957,2	3754,4	3914,4	741	1896,0	1976,0	3792,0	3952,0					
554	1858,6	1938,6	3717,2	3877,2	648	1877,4	1957,4	3754,8	3914,8	742	1896,2	1976,2	3792,4	3952,4					
555	1858,8	1938,8	3717,6	3877,6	649	1877,6	1957,6	3755,2	3915,2	743	1896,4	1976,4	3792,8	3952,8					
556	1859,0	1939,0	3718,0	3878,0	650	1877,8	1957,8	3755,6	3915,6	744	1896,6	1976,6	3793,2	3953,2					
557	1859,2	1939,2	3718,4	3878,4	651	1878,0	1958,0	3756,0	3916,0	745	1896,8	1976,8	3793,6	3953,6					
558	1859,4	1939,4	3718,8	3878,8	652	1878,2	1958,2	3756,4	3916,4	746	1897,0	1977,0	3794,0	3954,0					
559	1859,6	1939,6	3719,2	3879,2	653	1878,4	1958,4	3756,8	3916,8	747	1897,2	1977,2	3794,4	3954,4					
560	1859,8	1939,8	3719,6	3879,6	654	1878,6	1958,6	3757,2	3917,2	748	1897,4	1977,4	3794,8	3954,8					
561	1860,0	1940,0	3720,0	3880,0	655	1878,8	1958,8	3757,6	3917,6	749	1897,6	1977,6	3795,2	3955,2					
562	1860,2	1940,2	3720,4	3880,4	656	1879,0	1959,0	3758,0	3918,0	750	1897,8	1977,8	3795,6	3955,6					
563	1860,4	1940,4	3720,8	3880,8	657	1879,2	1959,2	3758,4	3918,4	751	1898,0	1978,0	3796,0	3956,0					
564	1860,6	1940,6	3721,2	3881,2	658	1879,4	1959,4	3758,8	3918,8	752	1898,2	1978,2	3796,4	3956,4					
565	1860,8	1940,8	3721,6	3881,6	659	1879,6	1959,6	3759,2	3919,2	753	1898,4	1978,4	3796,8	3956,8					
566	1861,0	1941,0	3722,0	3882,0	660	1879,8	1959,8	3759,6	3919,6	754	1898,6	1978,6	3797,2	3957,2					
567	1861,2	1941,2	3722,4	3882,4	661	1880,0	1960,0	3760,0	3920,0	755	1898,8	1978,8	3797,6	3957,6					
568	1861,4	1941,4	3722,8	3882,8	662	1880,2	1960,2	3760,4	3920,4	756	1899,0	1979,0	3798,0	3958,0					
569	1861,6	1941,6	3723,2	3883,2	663	1880,4	1960,4	3760,8	3920,8	757	1899,2	1979,2	3798,4	3958,4					
570	1861,8	1941,8	3723,6	3883,6	664	1880,6	1960,6	3761,2	3921,2	758	1899,4	1979,4	3798,8	3958,8					
571	1862,0	1942,0	3724,0	3884,0	665	1880,8	1960,8	3761,6	3921,6	759	1899,6	1979,6	3799,2	3959,2					
572	1862,2	1942,2	3724,4	3884,4	666	1881,0	1961,0	3762,0	3922,0	760	1899,8	1979,8	3799,6	3959,6					
573	1862,4	1942,4	3724,8	3884,8	667	1881,2	1961,2	3762,4	3922,4	761	1900,0	1980,0	3800,0	3960,0					
574	1862,6	1942,6	3725,2	3885,2	668	1881,4	1961,4	3762,8	3922,8	762	1900,2	1980,2	3800,4	3960,4					
575	1862,8	1942,8	3725,6	3885,6	669	1881,6	1961,6	3763,2	3923,2	763	1900,4	1980,4	3800,8	3960,8					
576	1863,0	1943,0	3726,0	3886,0	670	1881,8	1961,8	3763,6	3923,6	764	1900,6	1980,6	3801,2	3961,2					
577	1863,2	1943,2	3726,4	3886,4	671	1882,0	1962,0	3764,0	3924,0	765	1900,8	1980,8	3801,6	3961,6					
578	1863,4	1943,4	3726,8	3886,8	672	1882,2	1962,2	3764,4	3924,4	766	1901,0	1981,0	3802,0	3962,0					
579	1863,6	1943,6	3727,2	3887,2	673	1882,4	1962,4	3764,8	3924,8	767	1901,2	1981,2	3802,4	3962,4					
580	1863,8	1943,8	3727,6	3887,6	674	1882,6	1962,6	3765,2	3925,2	768	1901,4	1981,4	3802,8	3962,8					
581	1864,0	1944,0	3728,0	3888,0	675	1882,8	1962,8	3765,6	3925,6	769	1901,6	1981,6	3803,2	3963,2					
582	1864,2	1944,2	3728,4	3888,4	676	1883,0	1963,0	3766,0	3926,0	770	1901,8	1981,8	3803,6	3963,6					
583	1864,4	1944,4	3728,8	3888,8	677	1883,2	1963,2	3766,4	3926,4	771	1902,0	1982,0	3804,0	3964,0					
584	1864,6	1944,6	3729,2	3889,2	678	1883,4	1963,4	3766,8	3926,8	772	1902,2	1982,2	3804,4	3964,4					
585	1864,8	1944,8	3729,6	3889,6	679	1883,6	1963,6	3767,2	3927,2	773	1902,4	1982,4	3804,8	3964,8					
586	1865,0	1945,0	3730,0	3890,0	680	1883,8	1963,8	3767,6	3927,6	774	1902,6	1982,6	3805,2	3965,2					
587	1865,2	1945,2	3730,4	3890,4	681	1884,0	1964,0	3768,0	3928,0	775	1902,8	1982,8	3805,6	3965,6					
588	1865,4	1945,4	3730,8	3890,8	682	1884,2	1964,2	3768,4	3928,4	776	1903,0	1983,0	3806,0	3966,0					
589	1865,6	1945,6	3731,2	3891,2	683	1884,4	1964,4	3768,8	3928,8	777	1903,2	1983,2	3806,4	3966,4					
590	1865,8	1945,8	3731,6	3891,6	684	1884,6	1964,6	3769,2	3929,2	778	1903,4	1983,4	3806,8	3966,8					
591	1866,0	1946,0	3732,0	3892,0	685	1884,8	1964,8	3769,6	3929,6	779	1903,6	1983,6	3807,2	3967,2					
592	1866,2	1946,2	3732,4	3892,4	686	1885,0	1965,0	3770,0	3930,0	780	1903,8	1983,8	3807,6	3967,6					
593	1866,4	1946,4	3732,8	3892,8	687	1885,2	1965,2	3770,4	3930,4	781	1904,0	1984,0	3808,0	3968,0					
594	1866,6	1946,6	3733,2	3893,2	688	1885,4	1965,4	3770,8	3930,8	782	1904,2	1984,2	3808,4	3968,4					
595	1866,8	1946,8	3733,6	3893,6	689	1885,6	1965,6	3771,2	3931,2	783	1904,4	1984,4	3808,8	3968,8					
596	1867,0	1947,0	3734,0	3894,0	690	1885,8	1965,8	3771,6	3931,6	784	1904,6	1984,6	3809,2	3969,2					
597	1867,2	1947,2	3734,4	3894,4	691	1886,0	1966,0	3772,0	3932,0	785	1904,8	1984,8	3809,6	3969,6					
598	1867,4	1947,4	3734,8	3894,8	692	1886,2	1966,2	3772,4	3932,4	786	1905,0	1985,0	3810,0	3970,0					
599	1867,6	1947,6	3735,2	3895,2	693	1886,4	1966,4	3772,8	3932,8	787	1905,2	1985,2	3810,4	3970,4					
600	1867,8	1947,8	3735,6	3895,6	694	1886,6	1966,6	3773,2	3933,2	788	1905,4	1985,4	3810,8	3970,8					
601	1868,0	1948,0	3736,0	3896,0	695	1886,8	1966,8	3773,6	3933,6	789	1905,6	1985,6	3811,2	3971,2					
602	1868,2	1948,2	3736,4	3896,4	696	1887,0	1967,0	3774,0	3934,0	790	1905,8	1985,8	3811,6	3971,6					
603	1868,4	1948,4	3736,8	3896,8	697	1887,2	1967,2	3774,4	3934,4	791	1906,0	1986,0	3812,0	3972,0					
604	1868,6	1948,6	3737,2	3897,2	698	1887,4	1967,4	3774,8	3934,8	792	1906,2	1986,2	3812,4	3972,4					
605	1868,8	1948,8	3737,6	3897,6	699	1887,6	1967,6	3775,2	3935,2	793	1906,4	1986,4	3812,8	3972,8					

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10 — Schematics

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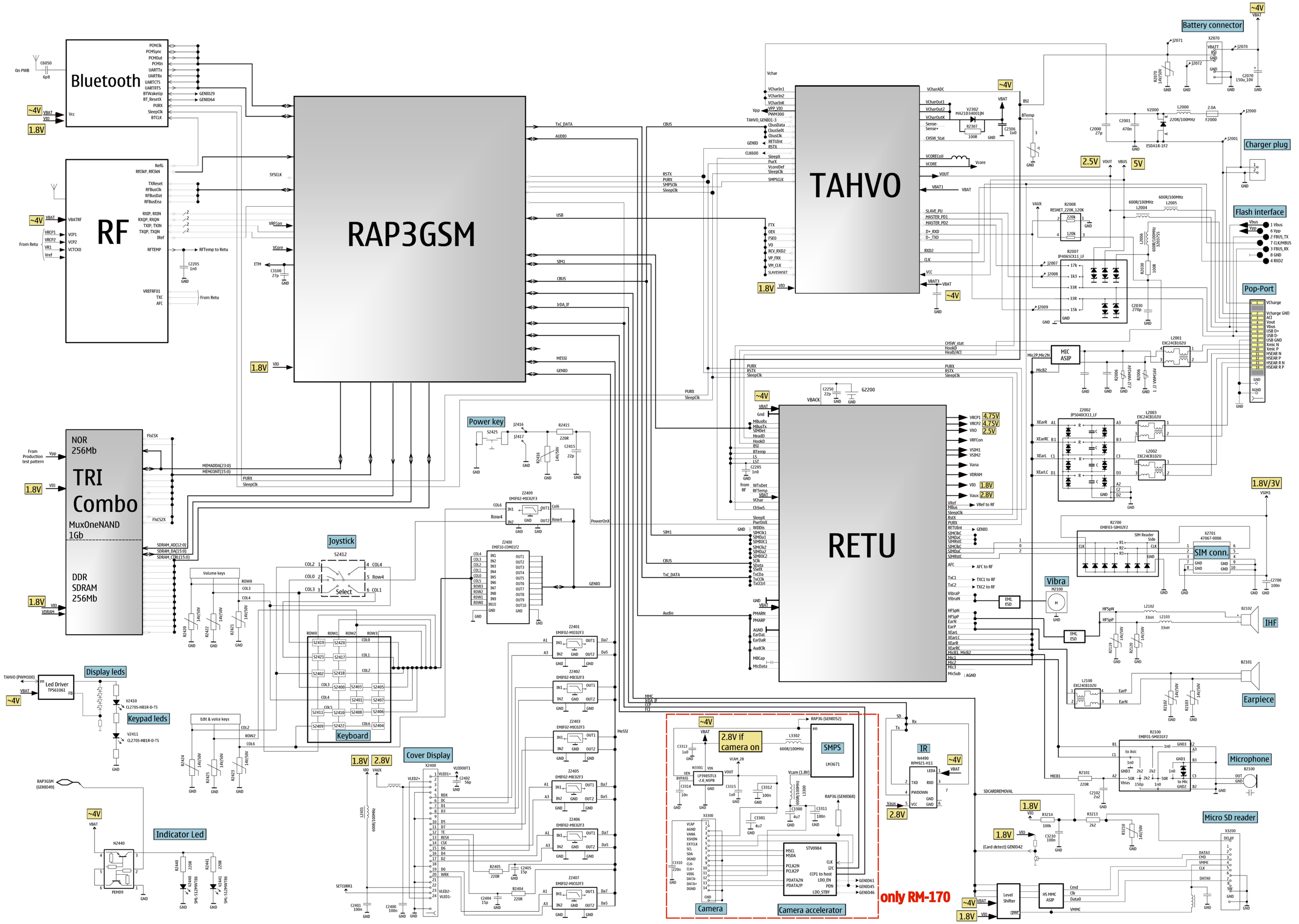
Table of Contents

Schematics..10–4

Schematics

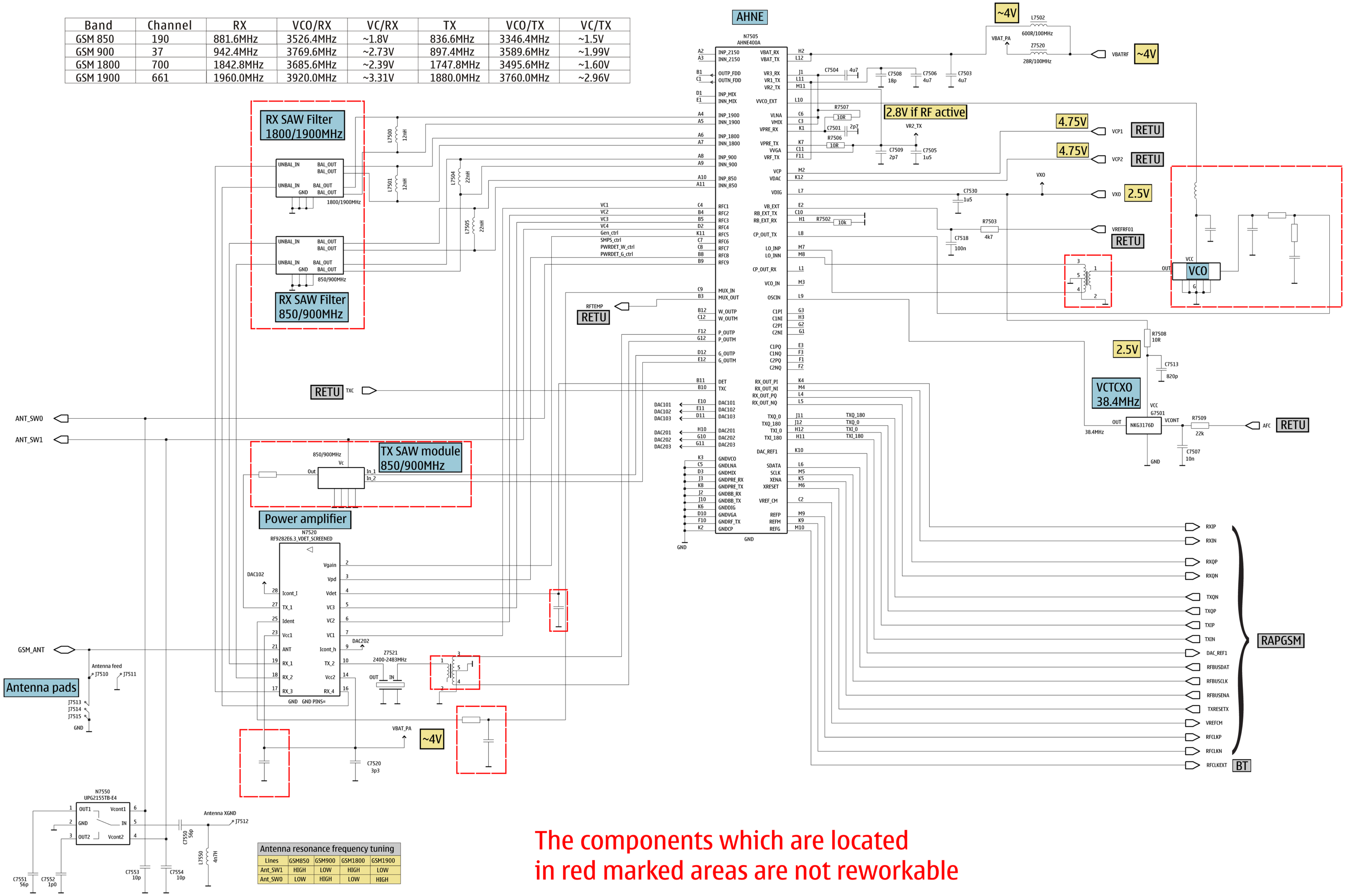
RF-BB connections


Bluetooth
RF
RAP3GSM
TAHVO
RETU
NOR 256Mb
TRI Combo
MuxOneNAND 1Gb
DDR SDRAM 256Mb
Battery connector
Charger plug
Flash interface
Pop-Port
Power key
Joystick
Keyboard
Display leds
Keypad leds
Indicator Led
Cover Display
Camera
Camera accelerator
only RM-170
IR
Vibra
IHF
Earpiece
Microphone
Micro SD reader
SIM conn.
2.8V if camera on
SMPS
~4V
1.8V
2.8V
2.5V
5V
4.75V
1.8V/3V

COMPANY CONFIDENTIAL

RF part

Band	Channel	RX	VCO/RX	VC/RX	TX	VCO/TX	VC/TX
GSM 850	190	881.6MHz	3526.4MHz	~1.8V	836.6MHz	3346.4MHz	~1.5V
GSM 900	37	942.4MHz	3769.6MHz	~2.73V	897.4MHz	3589.6MHz	~1.99V
GSM 1800	700	1842.8MHz	3685.6MHz	~2.39V	1747.8MHz	3495.6MHz	~1.60V
GSM 1900	661	1960.0MHz	3920.0MHz	~3.31V	1880.0MHz	3760.0MHz	~2.96V


AHNE
N7505
AHNE400A
~4V
L7502
600R/100MHz
Z7520
28R/100MHz
VBAT_PA
VBATRF
2.8V if RF active
4.75V
VCP1
RETU
4.75V
VCP2
RETU
VXO
2.5V
VREFRF01
RETU
VCO
RX SAW Filter
1800/1900MHz
RX SAW Filter
850/900MHz
L7500
12nH
L7501
12nH
L7504
22nH
L7505
22nH
RFTEMP
RETU
TXC
RETU
ANT_SW0
ANT_SW1
TX SAW module
850/900MHz
Power amplifier
N7520
RF9282E6.3_VDET_SCREENED
Vgain
Vpd
Vdet
VC3
VC2
VC1
Icont_h
TX_2
Vcc2
RX_4
Icont_l
TX_1
Ident
Vcc1
ANT
RX_1
RX_2
RX_3
DAC102
DAC202
Z7521
2400-2483MHz
GSM_ANT
Antenna feed
J7510
J7511
J7513
J7514
J7515
Antenna pads
VBAT_PA
~4V
C7520
3p3
2.5V
R7508
10R
C7513
820p
VCTCXO
38.4MHz
G7501
NKG3176D
VCONT
R7509
22k
C7507
10n
AFC
RETU
38.4MHz
N7550
UPG2155TB-E4
OUT1
Vcont1
GND
IN
OUT2
Vcont2
C7551
56p
C7552
1p0
C7553
10p
C7554
10p
C7550
56p
L7550
4n7H
Antenna XGND
J7512
RXIP
RXIN
RXQP
RXQN
TXQN
TXQP
TXIP
TXIN
DAC_REF1
RFBUSDAT
RFBUSCLK
RFBUSENA
TXRESETX
VREFCM
RFCLKP
RFCLKN
RFCLKEXT
RAPGSM
BT

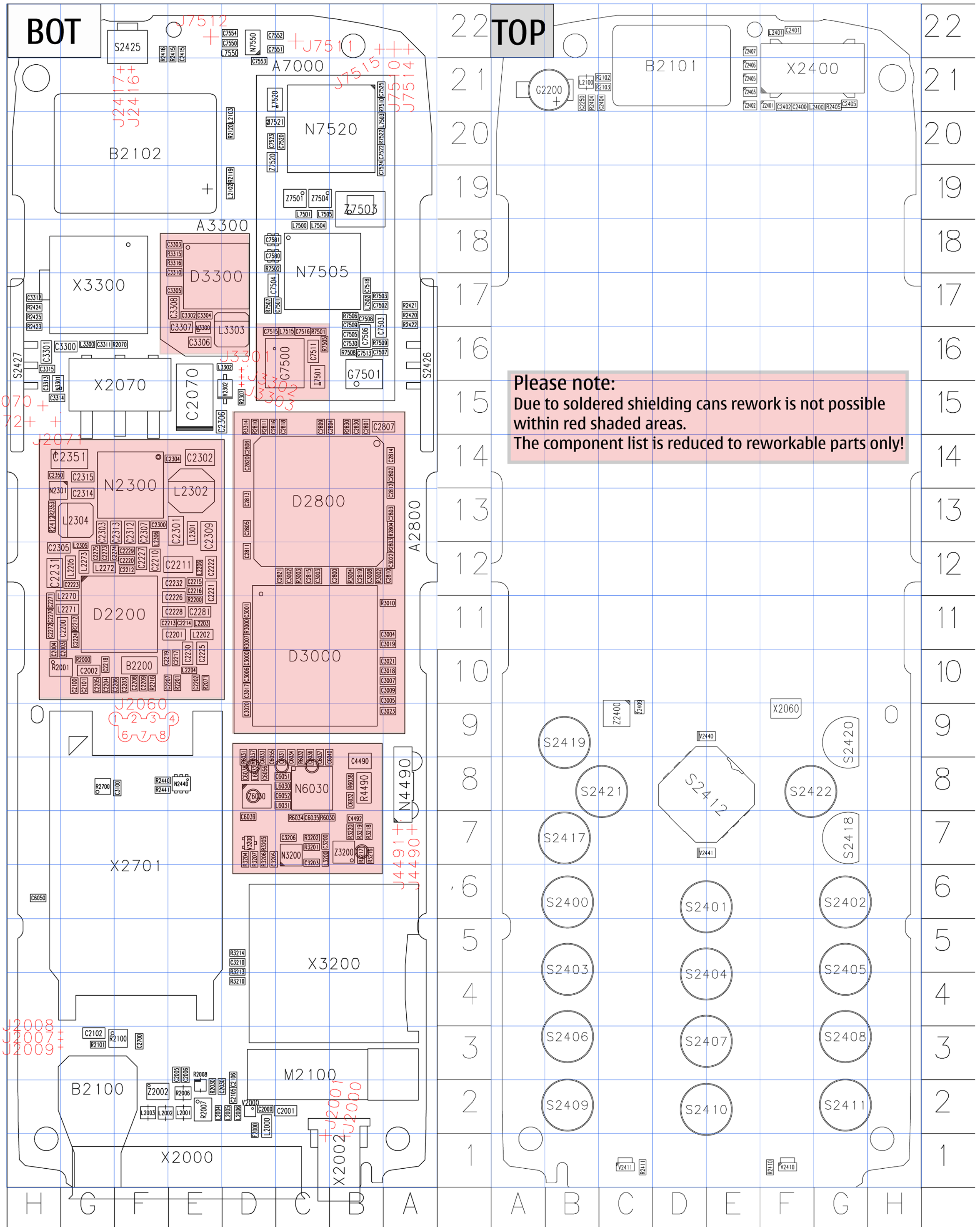
Antenna resonance frequency tuning

Lines	GSM850	GSM900	GSM1800	GSM1900
Ant_SW1	HIGH	LOW	HIGH	LOW
Ant_SW0	LOW	HIGH	LOW	HIGH

The components which are located
in red marked areas are not reworkable

Component finder

C	
C2000	D2
C2001	C2
C2030	E2
C2070	E15
C2102	G3
C2205	G10
C2206	F10
C2250	B21
C2306	E15
C2400	F21
C2401	F22
C2402	F21
C2404	C21
C2405	G21
C2415	E22
C2700	F3
C3100	F8
C3210	D5
C3300	G16
C3301	H16
C3310	E18
C3311	G16
C3312	H17
C3313	H15
C3314	H15
C3315	H16
C6050	H6
C7501	C17
C7503	B17
C7504	D17
C7505	B16
C7506	B16
C7507	B16
C7508	B17
C7509	B17
C7513	B16
C7518	B17
C7520	C20
C7530	B16
C7550	D22
C7551	D22
C7552	D22
C7553	D21
C7554	D22
F	
F2000	D2
G	
G2200	B21
G7501	B16
J1490	A7
J1491	A7
J2000	B1
J2001	C1
J2007	H3
J2008	H3
J2009	H3
J2060	F9
J2070	H15
J2071	H15
J2072	H15
J2416	F21
J2417	F21
J3301	D16
J3302	D16
J3303	D15
J7510	A22
J7511	C22
J7512	E22
J7514	A22
J7515	B22
L	
L2000	D2
L2001	E2
L2002	F2
L2003	F2
L2004	E2
L2005	D2
L2006	D2
L2100	B21
L2102	D19
L2103	D20
L2401	F22
L3300	G16
L3302	D16
L7500	C18
L7501	C19
L7502	B17
L7503	B20
L7504	C18
L7505	C19
L7515	C16
L7550	D22
M	
M2100	C3
N	
N2440	E8
N3301	H15
N4490	A8
N7505	C18
N7520	B20
N7550	D22
R	
R2006	E2
R2007	E2
R2008	E2
R2030	E2
R2070	F16
R2100	F3
R2101	G3
R2102	C21
R2103	C21
R2119	D19
R2120	D20
R2307	D15
R2404	B21
R2405	G21
R2415	E22
R2416	F22
R2420	A17
R2421	A17
R2422	A17
R2423	H17
R2424	H17
R2425	H17
R2440	F8
R2441	F8
R2700	G8
R3210	D4
R3213	D5
R3214	D15
R7502	D18
R7503	B17
R7506	B17
R7507	D17
R7508	B16
R7509	B16
S	
S2412	E8
S2425	F22
V	
V2000	D2
V2302	D15
V2410	F1
V2411	C1
V2440	E9
V2441	E7
X	
X2000	E1
X2070	F15
X2400	F21
X2701	F6
X3200	B5
X3300	G17
Z	
Z2002	F2
Z2400	C9
Z7401	F21
Z2402	E21
Z2403	E21
Z7405	E21
Z7406	E21
Z7407	E22
Z2409	C9
Z7520	D20
Z7521	D20


BOT
TOP
A7000
B2102
A3300
N7520
N7505
X3300
D3300
X2070
C2070
G7500
G7501
N2300
L2302
D2800
A2800
D2200
D3000
B2200
J2060
N6030
N4490
X2701
X3200
M2100
B2100
X2000
X2002
B2101
X2400
G2200
X2060
S2419
S2420
S2421
S2412
S2422
S2417
S2418
S2400
S2401
S2402
S2403
S2404
S2405
S2406
S2407
S2408
S2409
S2410
S2411
S2425
S2426
S2427
J7512
J7511
J7515
J7510
J7514
J2417
J2416
J2070
J2072
J2071
J3301
J3302
J3303
J4491
J4490
J2008
J2007
J2009
J2001
J2000
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
H
G
F
E
D
C
B
A

Please note:
Due to soldered shielding cans rework is not possible within red shaded areas.
The component list is reduced to reworkable parts only!

Glossary

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A/D-converter	Analog-to-digital converter
ACI	Accessory Control Interface
ADC	Analog-to-digital converter
ADSP	Application DPS (expected to run high level tasks)
AGC	Automatic gain control (maintains volume)
ALS	Ambient light sensor
AMSL	After Market Service Leader
ARM	Advanced RISC Machines
ARPU	Average revenue per user (per month or per year)
ASIC	Application Specific Integrated Circuit
ASIP	Application Specific Interface Protector
B2B	Board to board, connector between PWB and UI board
BB	Baseband
BC02	Bluetooth module made by CSR
BIQUAD	Bi-quadratic ,type of filter function)
BSI	Battery Size Indicator
BT	Bluetooth
CBus	MCU controlled serial bus connected to UPP_WD2,UEME and Zocus
CCP	Compact Camera Port
CDSP	Cellular DSP (expected to run at low levels)
CLDC	Connected limited device configuration
CMOS	Complimentary metal-oxide semiconductor circuit (low power consumption)
COF	Chip on Foil
COG	Chip on Glass
CPU	Central Processing Unit
CSR	cambridge silicon radio
CSTN	Color Super Twisted Nematic
CTSI	Clock Timing Sleep and interrupt block of Tiku
CW	Continuous wave
D/A-converter	Digital-to-analouge converter
DAC	Digital-to-analouge converter
DBI	Digital Battery Interface
DBus	DSP controlled serial bus connected between UPP_WD2 and Helgo
DCT-4	Digital Core Technology
DMA	Direct memory access
DP	Data Package

DPLL	Digital Phase Locked Loop
DSP	Digital Signal Processor
DtoS	Differential to Single ended
EDGE	Enhanced data rates for global/GSM evaluation
EGSM	Extended GSM
EM	Energy management
EMC	Electromagnetic compability
EMI	Electromagnetic interference
ESD	Electrostatic discharge
FCI	Functional cover interface
FPS	Flash Programming Tool
FR	Full rate
FSTN	Film compensated super twisted nematic
GND	Ground, conductive mass
GPIB	General-purpose interface bus
GPRS	General Packet Radio Service
GSM	Group Special Mobile/Global System for Mobile communication
HF	Hands free
HFCM	Handsfree Common
HS	Handset
HSCSD	High speed circuit switched data (data transmission connection faster than GSM)
HW	Hardware
I/O	Input/Output
IBAT	Battery current
IC	Integrated circuit
ICHAR	Charger current
IF	Interface
IHF	Integrated hands free
IMEI	International Mobile Equipment Identity
IR	Infrared
IrDA	Infrared Data Associasion
ISA	Intelligent software architecture
JPEG/JPG	Joint Photographic Experts Group
LCD	Liquid Crystal Display
LDO	Low Drop Out
LED	Light-emitting diode

LPRF	Low Power Radio Frequency
MCU	Micro Controller Unit (microprocessor)
MCU	Multiport control unit
MIC, mic	Microphone
MIDP	Mobile Information Device Profile
MIN	Mobile identification number
MIPS	Million instructions per second
MMC	Multimedia card
MMS	Multimedia messaging service
NTC	Negative temperature coefficient, temperature sensitive resistor used as a temperature sensor
OMA	Object management architechture
OMAP	Operations, maintenance, and administartion part
Opamp	Operational Amplifier
PA	Power amplifier
PDA	Pocket Data Application
PDA	Personal digital assistant
PDRAM	Program/Data RAM (on chip in Tiku)
Phoenix	Software tool of DCT4.x
PIM	Personal Information Management
PLL	Phase locked loop
PM	(Phone) Permanent memory
PUP	General Purpose IO (PIO), USARTS and Pulse Width Modulators
PURX	Power-up reset
PWB	Printed Wiring Board
PWM	Pulse width modulation
RC-filter	Resistance-Capacitance filter
RF	Radio Frequency
RF PopPort TM	Reduced function PopPortTM interface
RFBUS	Serial control Bus For RF
RSK	Right Soft Key
RS-MMC	Reduced size Multi Media Card
RSSI	Receiving signal strength indicator
RST	Reset Switch
RTC	Real Time Clock (provides date and time)
RX	Radio Receiver

SARAM	Single Access RAM
SAW filter	Surface Acoustic Wave filter
SDRAM	Synchronous Dynamic Random Access Memory
SID	Security ID
SIM	Subscriber Identity Module
SMPS	Switched Mode Power Supply
SNR	Signal-to-noice ratio
SPR	Standard Product requirements
SRAM	Static random access memory
STI	Serial Trace Interface
SW	Software
SWIM	Subscriber/Wallet Identification Module
TCXO	Temperature controlled Oscillator
Tiku	Finnish for Chip, Successor of the UPP, Official Tiku3G
TX	Radio Transmitter
UART	Universal asynchronous receiver/transmitter
UEME	Universal Energy Management chip (Enhanced version)
UEMEK	See UEME
UI	User Interface
UPP	Universal Phone Processor
UPP_WD2	Communicator version of DCT4 system ASIC
USB	Universal Serial Bus
VBAT	Battery voltage
VCHAR	Charger voltage
VCO	Voltage controlled oscillator
VCTCXO	Voltage Controlled Temperature Compensated Crystal Oscillator
VCXO	Voltage Controlled Crystal Oscillator
Vp-p	Peak-to-peak voltage
VSIM	SIM voltage
WAP	Wireless application protocol
WD	Watchdog
XHTML	Extensible hypertext markup language
Zocus	Current sensor, (used to monitor the current flow to and from the battery)